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DEPT. OF NATURAL RESOURCES & CONSERVATION
DIVISION OF FORESTRY

PRESCRIBED FIRE/AIR QUALITY GUIDELINES

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STATE OF MONTANA

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DEPT. OF NATURAL RESOURCES & CONSERVATION
DIVISION OF FORESTRY

PRESCRIBED FIRE/AIR QUALITY GUIDELINES

October 1972

FOREWARD

Fire in the forests of Montana is an essential, ecological force which, throughout history, has shaped and maintained the ecosystems we know today.

Fire in its catastrophic form must be controlled and prevented from occurring; accumulations of debris, buildup of fuels and related deterioration of the forest must be eliminated.

Proper treatment of forest fuels and the forest environment is essential in the maintenance of the well managed, working forest. The proper use of fire, prescribed for each site or each fuel type on an individual basis can effectively aid in proper forest management.

GARETH C. MOON
Administrator
Division of Forestry

INTRODUCTION

This manual is intended for use as a guide in the selection of the proper method or cominbation of methods of forest site or fuel treatment and for the use of prescribed fire as an effective management tool, at the same time minimizing deleterious effects of fire and smoke on the environment.

Many factors of fire control, silviculture, economics and social consequence must be considered in order to choose the proper method of disposing of slash, preparing a seedbed, etc. Necessary considerations in the management of the forest resource are the stand's silvicultural needs--site preparation necessary for the initiation and development of the future stand and the needs of the existing stand for its continued development.

Other factors affecting the fuel treatment decision are those of existing and/or potential fire hazards and risks--the potential for fire incidence on the site now and following treatment; and following fire occurrence, its potential to spread and resistance to control.

Environmental and social impacts are of prime importance in selecting treatment. Of utmost importance are the effects on wildlife, soils, and water quality. An attempt must be made to minimize adverse effects and even enhance resource values through fuel treatment. Consider also the effects on air quality and aesthetics.

The estimated cost of fuel treatment must be compared with available funding to do a quality job.

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PART I - BURNING OBJECTIVES

To apply fire scientifically and satisfactorily, the objectives and acceptability of the burn should be determined. Prescribed burning is feasible only if it is ecologically, economically and socially acceptable.

While management objectives may vary, two or more objectives can be accomplished simultaneously with the same or combined methods. Following is a list of various management objectives for using fire by prescription.

1. Hazard Reduction:

   To reduce or eliminate the threat of wildfire where fuels have accumulated from logging, old burns, thinning, or blowdown.

2. Site Preparation:

   To prepare an adequate seedbed or planting site for the establishment and development of the new stand of conifer species which are shade intolerant and require mineral soil for regeneration.

3. Cover Type Conversion:

   The conversion of one cover type to another; brush to grass, brush to trees, or one tree specie to another.

4. Insect and Disease Control:

   To control insects (bark beetles, budworm) and diseases (blister rust, mistletoe) through prescribed burning. The method may consist of cutting, piling and burning of individual trees or a broadcast burn through an entire stand. Burning for control of insects can be accomplished at any time of the year but is probably ineffective during peak of adult emergence.

5. Nutrient Recycling:

   To speed up natural fuel decomposition and deterioration by the use of fire. Most of the nutrients tied up by the fuel are released to the soil and become available for the establishment and growth of the new stand.

   An increase in soil pH following the fire occurs but generally is only temporary. Some nutrients are lost in the smoke but most remain in the ash and are available to the new stand. A certain amount of nutrient leaching will occur during rainstorms, but through bacterial action and good soil-exchange capacities mineral leaching will be minimized.

6. Forage and Browse Improvement:

   Burning for cover type conversion to improve browse production by releasing valuable species from competition. To increase

grass growth through periodic (although not annual) burning. To improve and increase browse production on critical winter game ranges through the promotion of basal sprouting of shrubs.

7. Land Clearing:

To eliminate or reduce materials left from certain types of clearing that would otherwise have to be expensively removed or buried.

8. Understory Control:

To remove an undesirable understory by the judicious use of fire. For example: Removal of a Douglasfir understory in a pine stand or grand fir under a larch canopy can be effected with a broadcast burn.

9. Watershed Management:

To increase water flow by prescribed burning to control duff depth or amount of herbage. The use of prescribed fire might be especially applicable in watersheds behind a municipal water system following appropriate studies.

10. Fire Behavior and Suppression Training:

Prescribed fires are applicable for fire control purposes. Their inclusion here is to point out that they, too, are prescribed fires and thereby entail careful planning and preparation.

The first type is the training fire, used to train suppression crews in fire behavior and suppression tactics.

Other types of prescribed fire in fire suppression activities take place on the fireline. They differ from managed prescribed fire only in the time allowed for planning and preparation. These are: (1) burnouts which are set to consume unburned fuels and (2) backfires which create a change in the energy output of of the main fire to effect control of the fire.

PART II - NON-BURNING METHODS OF FUEL TREATMENT

Many methods of forest site and/or fuel treatments are available to the land manager. Each one can be used singly or in various combinations based upon applicability and utility on the individual site.

Non-burning methods of fuel treatment are more fully described in the Hazard Reduction and Management Guides and will not be discussed in detail here. Non-burning methods and their purposes for site and fuel treatment are:

1. NATURAL DECOMPOSITION:

   Allows fuels to remain intact and in place and decompose slowly through natural processes. "No treatment" is usually coupled with supplemental protection.

2. HANDPILE WITHOUT BURNING:

   Breaks up the fuel's horizontal continuity. Fuel moisture is oftentimes decreased.

3. LOP AND/OR SCATTER:

   Rearranges fuel continuity, increases fuel moisture by bringing slash in contact with the ground, and accelerates decomposition. Both may or may not be done together; i.e., may be lopped without being scattered.

4. TRAMPLE OR CRUSH:

   Accelerates decomposition and changes fuel continuity and moisture content by dozer walking, rolling, etc.

5. CHIPPING:

   Changes fuel continuity and fuel size and accelerates decomposition.

6. MASTICATING OR SHREDDING:

   Increases fuel deterioration and changes fuel continuity.

7. FUELBREAK-FIREBREAK:

   These are not so much fuel treatments as methods of fuel management, by changing the continuity of fuels to enhance control or fire spread. Fuelbreaks and firebreaks may remove considerable acreage from effective production.

8. SUPPLEMENTAL PROTECTION:

   A method of non-treatment based on the calculated risk that fire suppression will be cheaper than fuel treatment. Increased patrolling is usually required. Here too, considerable acreage may be removed from production.

9. DOZER SCARIFICATION:

Generally, a site preparation measure to expose a more beneficial seedbed or to aid in planting accessibility.

10. CHEMICAL TREATMENT:

Entails the use of chemicals to speed deteriorations or to provide fire resistance. In our Intermountain West, spraying with bacteria, etc., to enhance deterioration has been found ineffective due to the dry, cold climate. Spraying with retardants to increase fire resistance is at best a temporary measure, but may be applicable in certain extreme instances.

11. UTILIZATION:

The complete utilization of the tree is allegedly the "cure all" for our fuels problems. However, problems of economics are paramount. An important consideration is the effect of complete product removal from the site. With increased utilization, the loss of soil nutrients and organic matter will theoretically increase; thereby reducing site and soil fertility.

12. BURYING:

Burying of fuels can be especially applicable in road construction. Some timber sale contracts allow burying in road fills. This method may also be feasible in areas of heavy fuel concentrations where burning is critical. However, should a fire start here, holdover and mopup problems are critical; also, the increased steepness of road fill slopes may inhibit big game movement.

PART III - BURNING METHODS OF FUEL TREATMENT

Three basic types of prescribed burning are applicable to forest management:

1. Pile and burn. 2. Spot burn. 3. Broadcast burn.

Variations of each are discussed as to their objectives, applicability and environmental and ecological effects.

PILE AND BURN

Piling and burning includes handpiling, swamper burning, dozer piling and yarding. Due to the timber types resulting in light to medium slash concentrations on most State and private lands, piling and burning is the most used and probably the most applicable method of slash disposal. Following are basic criteria for effective piling and burning operations:

1. Piles should be tight and compact.
2. Piles should contain sufficient fine fuels for fast, easy ignition and rapid fire spread.
3. Piles should be as large and as high as possible to provide as hot a fire as practicable, considering all economic and ecologic values.
4. Piling should be accomplished as soon as possible after logging.
5. Piles should be sufficiently far from standing trees or reproduction to avoid scorching.
6. Piles should be clean and free from dirt.

Also, piling operations are more applicable in some situations and under some conditions than others. Piling should be used on:

1. Areas in which fuel concentrations are too light or their continuity is such that broadcast burning will not attain desired objectives: i.e., broadcast in light, scattered fuels probably will not provide the intensity for site preparation.
2. Areas containing residual trees or reproduction which are to remain following treatment can be protected by piling away from them.
3. Areas in which seedbed preparation cannot be accomplished by broadcast due to deep duff. Most of our desired tree species germinate and develop best on mineral soil; therefore, duff removal may be essential and can be better accomplished through mechanical piling and scarification.

4. Areas containing an abundance of large logs, snags, etc., which will inhibit machine planting. Dozer piling can rearrange barriers to allow planting machine access.

5. Areas which, if burned in any other way, would not achieve smoke management objectives; for example, broadcast of light fuels would not produce the intensity of fire necessary for good smoke dispersal; while piling would concentrate the fuels for a better, faster burn with less smoke.

6. Areas in which non-burning alternatives may be too expensive and other burning methods may be too hazardous or aesthetically undesirable. For example, costs might be prohibitive for chipping or losses of residual trees would be undesirable if broadcast.

A. HANDPILE AND BURN:

Application:

Normal application of handpiling is in light fuel concentrations. Handpiling along roads, trails, through thinnings, or around recreational or other public areas can achieve a certain degree of hazard reduction by eliminating some of the risk involved. Handpiling generally achieves certain aesthetic objectives by improving the appearance of an area.

Handpiling can be used to remove slash concentrations which may inhibit grazing use such as within thinning areas. It can be used with nearly all types of cutting, with any species cut, and on nearly all types of topography. However, steep slopes are hazardous to crews and extreme care is necessary.

Procedures:

Large limbs and branches should be lopped and piled parallel, butts out, to provide a tight compact pile. Size of the pile is not important and is determined by:

1. The size of available openings.

2. The volume of slash.

3. The distance the slash must be carried to the pile.

Generally, though, handpiles should be 6 to 10 feet in diameter and 5 to 8 feet high.

Fines and bark placed on top will help shed water. Another way to keep piles dry is by covering with laminated paper, asphalt paper or visqueen plastic. Covering of the piles will allow burning to be accomplished at the land manager's convenience to schedule burning to:

1. Burn immediately following a heavy rain to enhance control in critical areas.

2. Burn during winter and lessen smoke pollution during critical periods.

3. Burn the next spring to accomplish both (1) and (2) above.

To locate covered piles in the winter in 2-3 feet of snow, imbed a "locator stick" vertically before winter.

Environmental Effects:

Handpiling will have little, if any, effect on soils. Heating of the soil directly beneath a pile may kill some of the organisms but the area affected is small and the duration of effects is short.

Piling of slash can enhance water quality. Limbs, tops, etc., can be removed from the stream bed where they might otherwise decompose, releasing organic acids through leaching. Handpiling, with or without burning, can retard soil movement by proper placement of piles in skid trails, etc.

Handpile burning invariably creates a low intensity fire whose smoke is subject to the whims of every breath of air. Especially critical are evening downslope winds which carry drift smoke into valley bottoms. The Area Supervisor should delineate smoke sensitive areas and areas of influence before considering handpiling and burning Burning of handpiles is not recommended on low slopes or in valleys where smoke sensitive areas would be affected.

Spring or early summer burning, with the aid of adequate suppression equipment, is another method of distributing the smoke load. Spring burning is not recommended in heavy fuels. Complete mopup may be necessary--make sure funding is adequate!

B. SWAMPER (PROGRESSIVE) BURNING:

Progressive burning is a modification of handpiling and consists of felling the timber and piling and burning the slash in one operation. Once the fire is started, slash is added as it is created. It is generally used in the late fall and winter when fuels are wet, yet a good cleanup is required.

This method is often used and is of questionable effectiveness in the control of insect (especially bark beetle) and mistletoe infestations. Swamper burning for insect control would accomplish destruction of the brood in the individual tree burned, but probably would have little or no effect in stemming an extensive infestation.

Air quality and fire hazard precautions applicable for handpiling are applicable here. In areas where slash disposal is necessary, yet smoke sensitivity is high, non-burning alternatives should be considered.

C. MACHINE PILE AND BURN:

Many of the objectives for which burning is done are met with the use of mechanical scarification and piling and burning. Hazard reduction objectives can be met in almost any fuel concentration where it is economical; generally, use on small areas and light fuels is prohibitive. Silvicultural treatments of site preparation

and cover type conversion can be simply and economically accomplished. Dozer piling is especially useful on seed tree harvests and on areas with clumps of reproduction.

Since production costs vary according to the degree of difficulty of a slash treatment job, the following should be used as guides in the decision to use dozers:

a. Slope: Mechanical methods are usually prohibitive if the slope is in excess of 35%.

b. Windfalls: Large numbers of windfalls will hinder piling efforts, particularly if long and large windfalls are encountered. However, removal of the windfalls will provide access for machine planting. Consideration must be given to the protection of established seedlings.

c. Snags: The number of snags encountered in the area is an important consideration. Do not leave standing snags within the area to be burned unless valuable as dens or nesting sites and safe from ignition.

d. Rock Outcrops: Rock outcrops tend to slow production because of increased problems in maneuverability and blade handling. In areas with a considerable number of rock outcrops mechanical methods may not be advisable.

e. Reserve Stand: Reproduction and larger trees left as a reserve stand must be protected from damage. This is especially critical in a selectively cut area. Both mechanical and fire damage can result.

f. Boggy Ground: Soft ground will limit the activity of mechanical equipment for slash piling; often by limiting the season of operation. Burning in peat areas deserve special consideration due to problems created.

Slope, windfalls and rock are probably the major considerations in rating an area for hazard reduction by mechanical means.

The following points should be considered when dozer piling:

a. Avoid piling in areas of excessive slope and fragile or unstable soils.

b. The amount and type of stand improvement work should be considered.

c. Where distribution of tree seed is desired, select the proper time for mechanical piling and scarification. Problems in scheduling projects to coincide with seed crops may result.

d. Mechanical operations are best accomplished from June 1 through October 30.

e. Select the proper size tractor. Often a tractor too small for the job is used and the work is unsatisfactory and costs may be excessive. Conversely, too large a tractor may cause excessive site disturbance. Transportation costs for dozers are high; therefore, the size of the job and the concentration of jobs within any given area are important.

Procedures for all piling are essentially the same. Dozer piles should be as large as practicable depending primarily on the distance the slash must be moved. Distances in excess of 100 feet from the pile may tend to become prohibitive.

Windrows (especially large ones) should be minimized as game movement is oftentimes restricted. Important consideration must be given to problems created by windrowing slash within rights-of-way. Periodic breaks in windrows will enhance game movement. Whenever practicable total or near-total right-of-way cleanup is preferred. Fuels should be parallel (within the pile) and sufficient fine material included to carry the fire.

As with handpiling, consider covering the piles to schedule the burning at a more convenient time. To insure a good tight pile, many operators begin piling around a stump, which provides anchorage. However, the forester in charge must determine if this will constitute a future fire hazard, requiring extensive mopup. Stump holes (especially large ones) should be noted, mapped and checked next fire season.

The most important criteria for a good dozer pile is cleanliness. To keep piles free from dirt a "brush blade" is required; piling should never be done with a straight blade. (Contractors will be required to have a straight blade present during the closed fire season).

Hydraulic controls on the dozer allows higher lifting of the blade and generally more concentrated and compact piling than with cable controls. Concentrate the larger piles toward the center of the unit and the smaller piles nearer the perimeter, to aid in smoke management and burn control. More than one convection column should be avoided as whirls may be created, affecting both control measures and smoke management.

Environmental Effects:

Dozer piling will affect soils in three basic ways:

1. Scarification of duff layers can allow considerable soil movement. How much depends on the quality of the operation. Contour scarification on slopes will minimize erosion; slash windrowed along slopes will act as barriers to soil movement; however, continuous windrows inhibit big game movement and sufficient openings are essential.

   In creeks or draws an undisturbed vegetative strip is essential for filtration and stream bank protection.

2. The extreme heat created during burning can be detrimental to soils, affecting the area beneath and immediately adjacent to the pile. The area taken up by the pile and therefore affected by this heat is generally small in relation to the total site, but consideration is nevertheless warranted.

3. A most severe effect of soils is through mechanical compaction. Constant travel by dozers across the slope will compact the soil, reduce soil porosity, and lower soil moisture holding capacity, all of which are vital to root penetration and plant development.

Water quality will be affected proportional to soil erosion. Dozer activity in, across, or adjacent to live streams should be avoided. Logs, trees or debris to be removed from the stream should be winched out or lifted out with tongs, grapples, etc; never dozed or pushed out.

Dozer piling and subsequent burning can produce large, hot, convective fires--if done properly. Proper piling and rapid ignition of dry piles will produce a high intensity fire with a good convection column. Plume height and direction can be predicted--similar to that from broadcasts. Per square foot of horizontal fuelbed, fire intensity is higher with dozer piles than with broadcast burning.

Smoke management is important! While smoke from the peak energy release may not be a problem, drift smoke from the cool-down can be. Smoldering remnants of a dozer pile can create definite problems during nighttime downslope winds or under inversion conditions.

Where smoke sensitive areas might be affected by drift smoke from piles, the piles should be ignited in the evening so as to produce highest intensity during the night to offset downslope winds and take advantage of upslope diurnal winds during the fire's cooldown period next day; i.e., peak fire intensity should coincide with downslope breezes, conversely fire cooldown should coincide with upslope winds. Smoke should not exist into the next nighttime period--if it appears as though it will, piles should be mopped up.

D. YARDING UNMERCHANTABLE MATERIAL:

Yarding is strictly a cleanup, hazard reduction measure used primarily along roads, landings, etc., to concentrate slash accumulations. This is generally an "operator-participation" method and should be appraised in the contract. Procedures simply entail yarding of fuels and piling within the right-of-way for disposal by burning.

The resulting burn is generally of low intensity and smoke problems will occur.

E. SPOT BURN:

Also called "Jackpot Burning", spot burning as a method of hazard reduction is used to reduce scattered, heavy fuel concentrations in areas where a broadcast fire will not carry through the fuels and

piling would be impractical. The intent is to eliminate the heavier fuel concentrations.

Spot burning in dry weather can be highly hazardous due to creeping fire through duff and litter and is most effective following a light shower which wets surrounding fine fuels.

Spot burning creates a low intensity fire and drift smoke may cause problems. Mopup is essential if a potential danger from wildfire exists or if the residual smoke will cause problems. Consideration of adequate funding is essential.

F. DIRECTIONAL FALLING:

Directional falling of the trees is especially effective on post and pole operations in lodgepole pine where most or all the stems are cut. The sawyer can windrow the slash by falling the trees in one direction.

Directional falling can also be used along the perimeter of logging units to aid in reducing slash concentrations along the boundary. All timber would necessarily be felled perpendicular to and away from the unit boundary. Removal of the merchantable stem would then leave a minimum of slash along the line.

The prescription for burning here may be one of broadcast burning or burning of dozer piles. The resultant fire would probably be of low intensity and smoke problems can occur.

G. INCINERATOR BURNING:

Specially fabricated, open-top burners have been successfully used to burn slash at costs comparable to piling andburning. Material is consumed rapidly as it is fed to the unit, regardless of the moisture content of fuels. The unit is fed by a front end loader or other suitable equipment, preferably track-laying. The incinerator is mobile and moved as necessary with the loading equipment.

H. BROADCAST BURNING:

All of the objectives for which burning is accomplished can be achieved to some degree through broadcast. Broadcast burning is generally applicable only in fuels of fairly heavy concentration possessing good continuity.

As a hazard reduction measure in heavy fuels, broadcast burning does a superb job of eliminating fine and medium fuels. While accurate quantitative data are not available, burning does recycle organic nutrients back into the soil. Seedbed preparation is better accomplished through boradcast burning except in areas of heavy duff.

A certain degree of insect and disease control could be accomplished with the use of broadcast burning; although a high degree of hazard exists. Cover types can be effectively managed, especially on areas of light fuels such as grass or brush types. Browse and forage production can be efficiently, effectively, and inexpensively managed

through basal sprouting of shrubs, reducing competition, and setting back ecological succession.

Undesirable understory species can be effectively eliminated with careful use of broadcast fire. Some degree of thinning in pole-sized ponderosa has been accomplished in areas and may be considered for State lands if applicable.

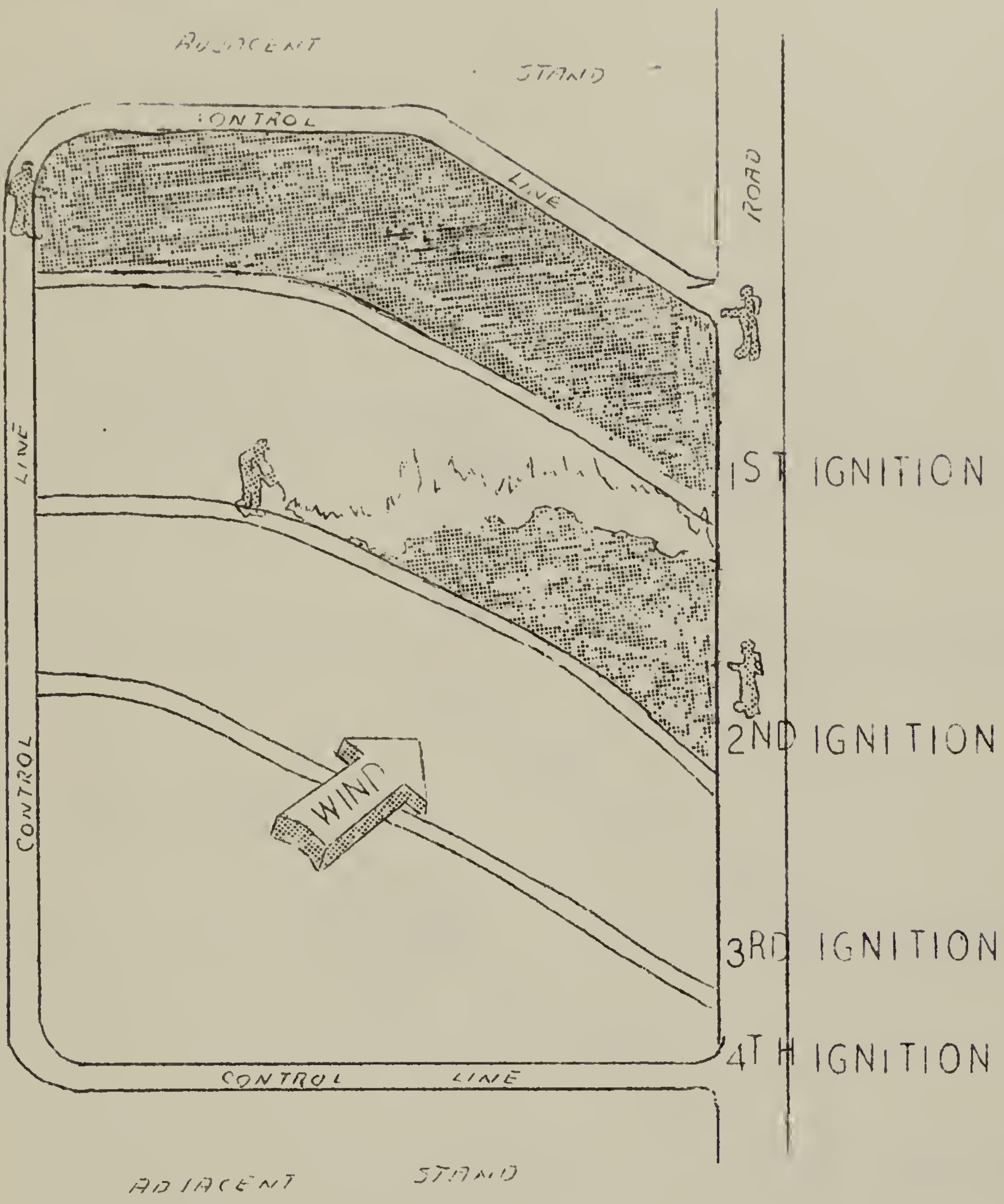
Four basic techniques of broadcast burning are applicable. Each technique can be used effectively depending upon desired objectives. They are:

1. Strip Headfire
2. Strip Backfire
3. Flanking Fire
4. Center Ignition

These same iginition techniques, with slight modification, are also applicable in pile burning.

Funding and manpower are probably the limiting factors for proper broadcast burning on State lands. For effective ignition and control operations it may be difficult to provide sufficient manpower to do the job. However, such conditions will become apparent while preparing the Burning Plan. (See Part IV - Burning Plan)

1. STRIP HEADFIRE:



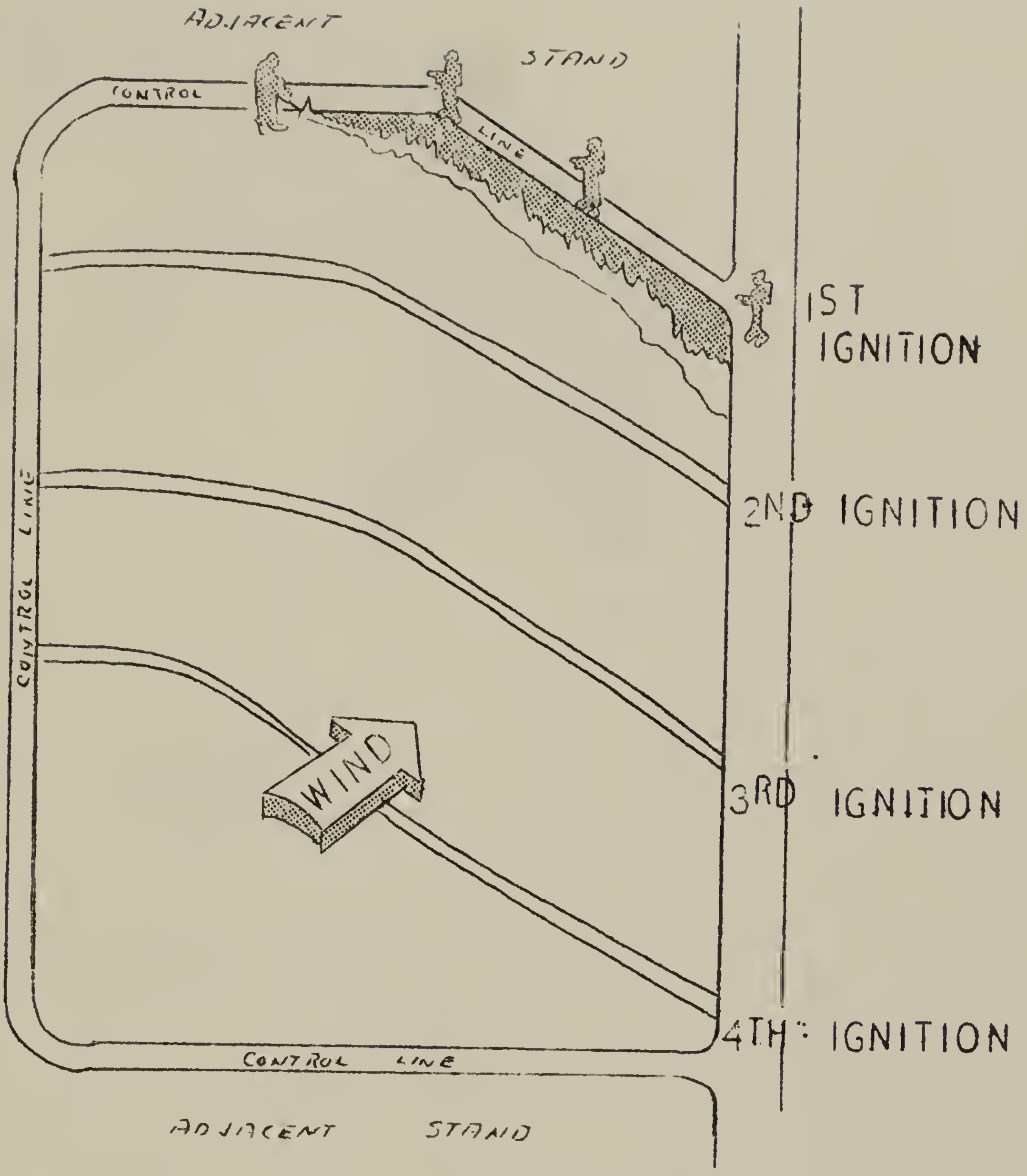
The strip headfire technique consists of lighting a strip of fire and allowing it to spread with the wind until it is stopped by a previously burned safety strip or a prepared fireguard. This technique is used when it is desired to burn large areas in a short time.

In order to burn out the safety strip, a backfire (or many very narrow strip headfires) should be started on the extreme downwind side before ignition of the first strip headfire.

After the safety strip is prepared, headfire strips are usually 2 to 5 chains wide but may vary according to local conditions.

Headfire intensity is greater than backfire, and when used under overstory (seedtree, etc.) are more likely to scorch crowns. Headfires can be used when humidity and fuel moisture are high or when fuel continuity is poor. Because it may move too rapidly, headfires may not effectively consume large fuels lying close to the ground.

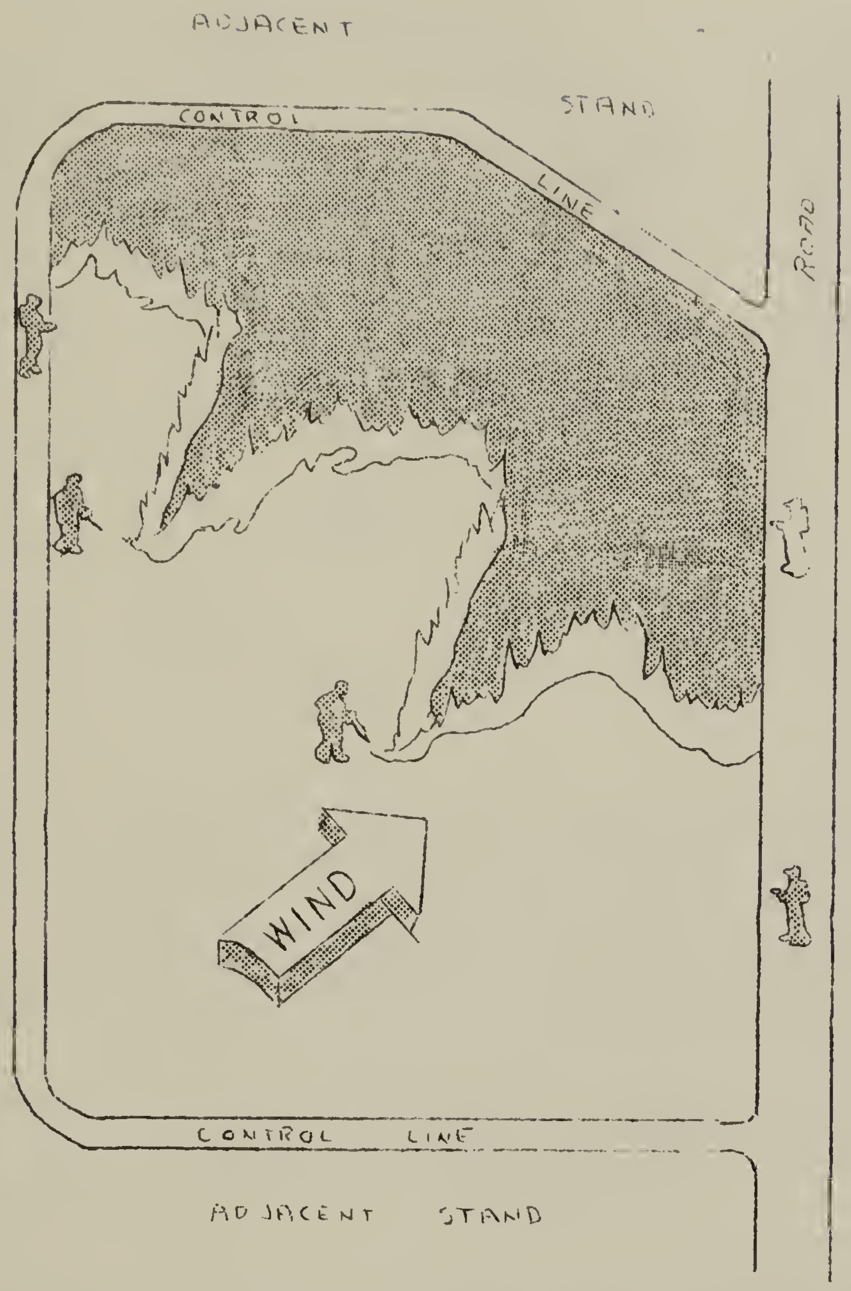
2. STRIP BACKFIRE:



The backfire technique consists of lighting the downwind side of an area and allowing it to burn into the wind. Backfires will advance 1 to 2 chains per hour depending on conditions of fuel, weather, and topography.

Because of its slow advance, a backfire is relatively easy to control and can be more safely executed during periods of high winds and dry conditions. However, the strip backfire cannot be used to burn large areas rapidly. This method can be used under a canopy since convective heat is minimized. A backfire tends to dwell longer on the site; therefore, total heat released at any point is greater; for this reason fuel consumption may be more efficient than with a headfire.

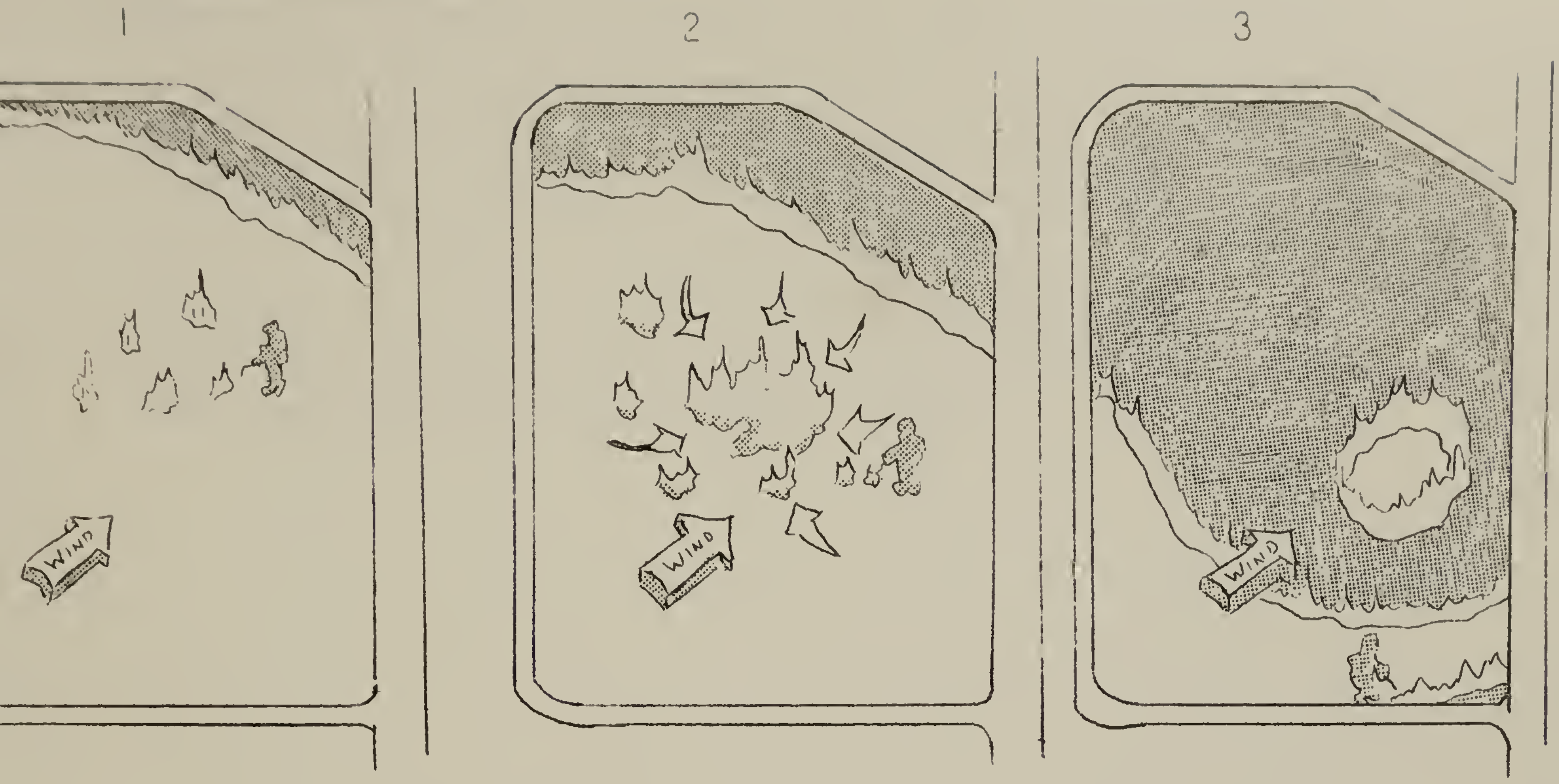
3. FLANKING FIRE:



The flanking fire technique consists of a strip of fire, lighted parallel with the wind, which burns at right angles to the wind. This combines the effect of both the headfire and backfire.

A good knowledge of fire behavior is important and the flanking fire should be used only if winds are constant in direction. Extreme care and preparatory control measures are essential.

4. CENTER IGNITION:



Center ignition (or spot firing) requires considerable knowledge of fire behavior. When used properly, center firing can be the most effective and reliable technique of broadcast burning; and is particularly useful for burning heavy slash concentrations when windspeed is low. This method works well when wind direction is variable. However, caution should be taken as variable winds may indicate atmospheric instability.

Center ignition consists of simultaneously lighting several fires in the center of the area to be burned. When it is evident that air is being drawn inward, the outer portions (still well within the perimeter) are ignited, followed by ignition of the perimeter.

A strong convection column is created and fuel is rapidly consumed. Large areas can be burned in a very short time using this technique. For a strong, intense fire, proper spacing and speed of ignition are critical.

For small areas, this technique may be used to effectively eliminate small patches of reproduction from the burn.

5. AREA IGNITION:

Area ignition, actually a modification of center ignition, is used when all parts of an area are to be ignited simultaneously; usually by remote control.

Environmental Effects:

Broadcast burning actually "lays the lightest" on the environment; the effect on soil structure is negligible; soil temperatures deeper than 1 1/2 inches below the surface rarely exceed 130° F. which is insufficient to kill the deep-rooted shrubs, etc. A certain amount of water contamination may occur due to mineralization of runoff, but with a vegetative buffer zone left along live streams, the pollution effects should be minimal. With the bulk of medium and heavy fuels remaining on the ground after the burn, soil erosion is minimized.

A broadcast burn (except in light fuels) is generally a high energy burn and, as with dozer piles, will produce a good convection column. Post-burn drift smoke may create air pollution problems in critical areas, in which case, consideration must be given to mopup.

PART IV - THE BURNING PLAN

For efficient, safe and economical prescribed burning, careful, thorough planning is essential. Planning for the burn insures that all important considerations, outlines, schedules, objectives, etc., are made.

Planning begins with conception of the project; in most cases with the presale work. Often, this planning should begin with the Management Plan, especially if objectives are other than slash disposal.

The burning plan should include the following:

1. Determination and statement of specific objectives.
2. Survey analysis of the area.
3. Prescriptions for burning each area including financing.
4. Appraisal of results and report of accomplishment.
5. An environmental statement including air, water, and soil.

A. Burning Plan Outline:

The following outline includes most of the items which must be considered in planning for an effective burn and will be helpful in preparing your burning plan.

1. Objectives of the burn:
    - a. Hazard Reduction
    - b. Site Preparation
    - c. Understory Control
    - d. Other (see Part I)
2. Limitations.
3. Description of the burning unit.
    - a. Section, Township, and Range
    - b. Drainage features, slopes, aspect, etc.
    - c. Risks and hazards.
4. Large scale maps showing:
    - a. Starting point and firing sequence
    - b. Locations of holding crews, tankers, waterholes, roads, etc.
    - c. Critical points and topographical features
5. Plans for firing and holding:
    - a. Time of day
    - b. Firing method and sequence

c. Manpower needs and distribution for:

1. Firing
2. Holding
3. Patrolling
4. Mopping up

d. Equipment needs and distribution
e. Communication needs
f. Reinforcements--numbers and location
g. Expected fire behavior and desired conditions
h. Instructions for overhead
i. Test of burning conditions

6. Alternative plans of action.

7. Fire Weather:

a. On-site data, weather history
b. Spot weather forecasts
c. Long-range outlooks

8. Publicity.

9. Personnel Safety.

10. Mopup

11. Appraisal of burn and reports.

a. Windspeed and direction
b. Fuel moisture
c. Humidity
d. Temperatures
e. Days since precipitation
f. How the burn reacted
g. Environmental impact including air, soil, and water

Remember! The burning plan is for use on the ground....make it useable!

The level of formality and depth of planning will be based upon the severity, size and impact (social and environmental) of the burn. The outline provides a ready checklist to insure all considerations are made; the following explains some of these considerations:

1. Burning objectives:

First and foremost are the objectives to be achieved. Last minute decisions necessitated by weather factors can be made only in terms of these objectives. Proper weather is vital to achieve certain objectives such as adequate site preparation or understory removal. Cancellation may be necessary due to unsatisfactory conditions; these conditions must be prespecified in the plan.

If the area is generally wet, an early fall burn may be indicated; a dry site may allow postponement to a late fall or even a spring burn. Scheduling of the burn will affect the smoke load during critical periods.

2. Limitations:

Limited funds, equipment and manpower, adjacent ownership problems, air quality controls, or departmental policies must be weighed. A burning plan, no matter how good, is worthless if it is not realistic.

3. Description of the Burning Unit:

Proper location of the unit by legal description is always necessary, especially if the burn is postponed, people are transferred, etc. All features of drainage, slope, aspect, etc., should be listed, as well as patches of residual timber, road locations, etc.

Also of prime importance in describing the burning unit are risks and hazards. Some of these may be included under limitations such as adjacent ownership or proximity to summer homesites. Also consider others such as topographic effects causing turbulent winds, proximity to easily ignited fuels, dog legs in the unit boundary, etc. The burn area may contain deep duff or considerable rotten or punky material which may need extensive mopup.

List all potential trouble spots!

4. Large scale maps:

The 8" per mile scale maps presently used for brush disposal should be adequate. Indicate all pertinent details.

5. Plans for firing and holding:

What day and what time of day will ignition occur? Method(s) and pattern(s) of firing are important as is the rate of ignition.

Simultaneous ignition of many spots within a block will create a hot convection column. Strip firing on steep slopes will facilitate control. Leapfrog ignition of dozer piles may save time through radiant ignition of adjacent piles.

Planning the ignition patterns also helps insure personnel safety. Each man then knows where he is to work and the supervisor knows where he is working.

Manpower needs--the following items generally determine manpower necessary to do the job.

a. Size of area--chains of perimeter.
b. Complexity of the area's topography.
c. Ignition pattern(s).
d. Control requirements.
e. Scouts needed.
f. Mopup required.
g. Kind of personnel available.
h. Availability of personnel.
i. Safety - Economy - Funding.
j. Considerations of environmental impact.

Equipment--proper and sufficient amounts of equipment are necessary for a quality burning job.

First, consider the preburn, planning equipment, especially weather equipment including belt weather kits, hygrothermographs, etc.

Other equipment needed is ignition equipment. The following lists types of ignition devices, their advantages and disadvantages:

Ignition Device	Advantages	Disadvantages
1. Matches	Always available in quantity Rapidly dispensed Inexpensive	Require fine, dry fuels Localized ignition Poor in wind
2. Fuses	Light in weight May be extended on pole Hot, concentrated flame Relatively long burning May be thrown Inexpensive	Require fine fuels Localized ignition No residual effect
3. Propane torches (backpack)	Very hot flame Long burning Maintain own pressure Good for piled slash and some broadcast burns	Heavy and awkward Time-consuming refill Refill can be hazardous No residual effect
4. Jellied petroleum products in sausage casings	May be ignited with fuse Good for piled slash Persistent flaming	Require presetting Possible detrimental effects on insect life
5. Diesel flamethrowers (truck-mount)	Long residual flame Long burning Fast roadside ignition Wide ignition pattern	Restricted to near roads Require gasoline pump Require large quantities of fuel Reflect intense heat and require protective clothing
6. Diesel flamethrowers (backpack)	Residual flame Easy refill	Heavy and awkward Require pressurizing
7. Drip torches	Residual flame Light and portable	Need frequent refills Fuel mixing
8. Very flares and thermite grenades	Some residual effect Remote ignition possible	Expensive May burn too hot for slash ignition
9. Remote ignition	Rapid ignition Insures crew safety	Expensive Need to be preset

Heavy equipment for fireline construction, road building, piling, scarification and control of fire should be listed.

Equipment needs will be determined by:

a. Development of area (roads, trails, etc.)
b. Escape potential of fire.
c. Presence or lack of water.
d. Efficiency and economic considerations (manpower and handtools vs. machinery)
e. Communication needs: Proper communication warrants specialized equipment and should be given special consideration. Adequate on-fire communication is essential for efficiency and safety. Knowledge by the firing boss of what is going on is vital. Radios should be issued to selected personnel stationed at strategic points around the unit. Also, a good communication link with the Area or Unit Office is required, especially for emergency situations.

6. Expected Fire Behavior and Alternate Plans:

Determine and plan for expected fire behavior and conditions desired to produce this behavior. At the same time know your area; know where the fire will go if it gets away; know what to do if it does. In other words, plan for unexpected fire behavior. An alternate plan of action is necessary to insure control (more than one alternative may be needed).

Oftentimes creeping "escaped" fires enhance future fire protection through the cleanup of accumulated natural fuels. If such conditions are desired, this must be part of the prescription.

The impact of the fire on the quality of the air is an important consideration. Considerations of smoke management must be included in the burning plan. What is the expected plume behavior, column height or plume direction? Consider also the effects of residual drift smoke following burning operations. A more complete discussion of air quality and its relation to prescribed burning follows in Part VI.

7. Fire Weather:

Adequate weather data, including history, trends and forecasts are vital to an effective burn. On-site instrumentation coupled with daily district-wide forecasts will normally provide sufficient information.

8. Publicity:

Final preparations include necessary publicity. The public has a right to know what is going on. Area Supervisors should prepare a news story for release to the media:

a. Prior to the burning season
b. Prior to any unusual burning
c. Prior to any large burn
d. Any other appropriate times

The stories should contain sufficient factual information to alleviate local fears and explain the necessities for the burn; in other words, to inform the public as to:

a. What is being done!
b. Who is doing it!
c. Where it is!
d. Why it is being done!
e. When it will take place!

Final preparations also include final recording of weather and fuel data. Especially important are weather trends and forecasts.

9. Personnel Safety:

Only one consideration is more important than getting the job done--getting it done safely!

Well in advance of the burning operation, a thorough, careful briefing is necessary to orient the crews to the total job to be done. If at all possible, especially on large or unusual burns, portions of this briefing should take place on the site. Each crew member should know his duties and his responsibilities.

Now is the time to clarify trouble spots, danger points, etc. A final readiness check of equipment and supplies is necessary. It is difficult to fill a propane torch in the field with the "pigtail" at the office.

Discuss any alternative plans of action in case anything should go wrong. Reiterate and emphasize safety standards and safety considerations, including escape routes.

Following are a few considerations concerning personnel safety:

a. Recruitment (health, physical ability, age)
b. Clothing and protective equipment
c. Characteristics of area to be burned (snags, heavy fuel jackpots, poor footing, etc.)
d. Use and peculiarities of equipment (especially firing devices)
e. Warn against smoke inhalation for extended periods
f. Stress necessity of following instructions and staying in touch with the rest of the crew.

Don't assume that the men know their jobs--feedback before the job may prevent an unnecessary accident later.

Don't touch off the fire until you've considered every angle to protect your men and equipment!

10. Mopup:

Following the burn, the area must be mopped up and/or patrolled as necessary. The rule of thumb here is "mopup to wildfire standards!" For example, a wildfire in late October or during a rainstorm may not warrant extensive mopup ... On the other hand, a prescribed

burn with expected severe conditions--or a spring burn--would require extensive mopup and patrol. Costs of mopup will come out of project funds...Plan for it!

11. Appraisal of the Burn:

Because so little is known about individual fuels, topography, and conditions affecting the prescribed burn, keep good records of events as they occur. Maintain a history and log of weather data, and after the burn is done, record the reaction of the burn. Did all go as expected? What was the plume behavior? Were burn objectives met?

Answers to these and other questions are needed to increase our knowledge in the use of fire.

PART V - FACTORS AFFECTING THE BURN

Numerous factors will affect the quality of the burn--whether hand pile, dozer pile or broadcast--factors of fuel, topography, and weather. In these guidelines these factors will be mentioned only as they are pertinent and relate directly to prescribed burning. A more complete discussion of fire behavior and factors influencing it can be found in #7, References and Suggested Reading, Appendix.

A. FUEL CHARACTERISTICS:

Vegetation exists as fuel particles and conglomerates of these particles, many properties of which affect the nature of the burn. The most important of these fuel characteristics are: 1) size, 2) quantity, 3) continuity, 4) moisture content, and 5) curing.

1. Fuel size--the size, weight and surface volume of fuels greatly affects ignition and fire spread. Fine fuels, especially thin ones (needles, etc.) have large surface to volume ratios; hence, they respond quickly to changes in moisture, ignite easily, and spread quickly. Fines are absolutely necessary for effective pile burning! Pile fuels before the fines are lost!

2. Fuel quantity--the amount of available fuel determines the burn's potential intensity and rate of spread. The larger the pile, the faster and hotter it will burn...also, the more hazardous will be the control. Insure that a proper ratio of fine to heavy fuels exists.

3. Fuel continuity--the arrangement and compaction of fuels influences the energy release rate of the fire and its rate of spread. For example, good horizontal continuity is necessary for broadcast burning; good vertical continuity for pile burning; for understory removal, however, poor vertical continuity is desired...such as under mature larch or pine. Wind speed can overcome small fuel discontinuities. Fuel preparation measures will affect continuity--such as lopping, scattering, piling, line building, etc.

4. Fuel moisture content--dead fuels respond quickly to changes in weather conditions and evaporation potential. Green fuels do not respond as readily due to their physiologically bound water. Ignition and fire spread is usually severely limited when moisture contents (M.C.) are 20-30% or higher. For example, needles are still limber at 20% M.C.

   The timelag for a fuel (time it takes to respond to external moisture changes) is directly related to fuel size; fine fuels respond daily (some hourly); logs, etc., may respond only seasonally. Relative humidity is a good indication of fine fuel (especially grass) moisture content.

   Generally, fuels under a forest canopy remain moister than

fuels exposed in a cutting unit; however, following a rain, the reverse is usually true--exposed fuels will be wetter than those sheltered by the canopy.

The fuel moisture content can be estimated by:

a. The Fire-Danger Rating System, which is a function of relative humidity and fuel moistures. This is especially useful in determining ignition potential; however, fire spread and intensity in heavy fuels is not so easily estimated.

b. Fuel Moisture Sticks. A set of these sticks consists of four 1/2 inch Ponderosa pine, sapwood dowels, spaced 1/4 inch apart on two 3/16 inch dowels; each set is adjusted to weigh 100 grams, ovendry. The sticks are placed on wire brackets 10 inches above the fuel bed. Periodic weighings (at least once a day) gives their indicated moisture contents (computed from their known dry weights). This indicated moisture is valuable primarily due to its representing the cumulative effects of past weather conditions.

   It is recommended that fuel-moisture sticks be used on all large burns (dozer-piled or broadcast) and on any specialty type burns such as understory removal, browse production, etc. Area Supervisors should requisition sticks well in advance of the field season.

c. Observation and Feel. This basis for estimation entails considerable field experience and a broad knowledge of fire behavior, atmospheric effects on fuels, and fuel characteristics. Dryness can be easily estimated by breaking twigs, soil moisture can reflect fuel moisture; time since last rain and a knowledge of evaporation will aid in estimating moisture content.

5. Fuel curing--aging or curing of fuels greatly influences fuel moisture. Green fuels with physiologically bound water do not ignite easily; whereas, cured fuels, with free water, do. However, very old fuels, due to compaction, deterioration, and the damping effect of surrounding vegetation may not ignite or carry fire easily.

   A minimum of one to two summer months of curing is necessary for good burning of logging debris.

B. FUEL PREPARATION:

Adequate fuel preparation, both inside and outside the unit, is necessary to insure that burning objectives will be met.

Inside the burning unit fuels should be rearranged (lopped, scattered, piled, windrowed, smashed, etc.) as necessary. All standing dead (and live, in case of broadcast headfire) should be felled to enhance control.

Outside the unit it may be necessary to scatter heavy fuel concentrations (especially the fireline berm) and apply retardants as necessary. Retardant application and sprinkler systems, especially on large hot burns may be quite applicable and relatively inexpensive considering the fire's potential for escape. Many prescribed burns do not meet specific silvicultural objectives because the threat of escape precluded adequate fire intensity doing the job. Retardant application, especially at danger points, will enhance control by slowing down the fire. Retardants are applied to either unburned fuels outside the unit to prevent their ignition or within the unit to slow the fire and reduce perimeter intensity.

Sprinkler systems, consisting of rain-bird type sprinkler heads spaced at various intervals on pipe or hose to wet down vegetation outside the unit and prevent escape of the fire can be effective and relatively inexpensive.

Purchaser participation, insured through timber sale appraisal and contract specifications, can accomplish much of the work of fuel preparation. Variations in methods of falling, skidding, yarding and fireline construction, snagging clauses, etc., are some ways of accomplishing fuel preparation measure during logging operations.

One new method of fuel preparation which may have applicability is the newly developed "slash breaker." This cable or hydraulicly operated breaker can reduce fuel size to enhance decomposition or burning operations.

C. METEORLOGICAL CONDITIONS:

There is no substitute for weather measurements as an aid in determining when to burn to attain desired objectives. Weather factors before, during and after the burn must be considered, as their effects can be critical.

Proper weather conditions are necessary to 1) obtain a satisfactory burn, and 2) obtain good smoke dispersal thereby minimizing local air pollution.

1. Wind--surface windspeeds will affect:

    a. Fuel drying and fuel moisture content,
    b. Rate of fire spread,
    c. Behavior of smoke plume and convection column,
    d. The rate of flaming and glowing (which may cause spotting, etc.),
    e. The completeness of the burn (a reburn may occur).

    Wind direction will influence plume behavior and carry indicators of changing weather. Wind speed and direction aloft will affect the smoke column height and mixing depth.

2. Precipitation--amounts and duration of precipitation 1) prior to the burn affect fuel moisture content, soil moisture, and the moisture contents of surrounding vegetation; and 2) during the burn influence ignition, rate of spread, and completeness of the burn.

3. Relative humidity--humidity trends before the burn are critical.

   Daily changes and trends affect fuel moisture which correspondingly influences ignitability. During the burn the direction of trend (up 10%--down 15%) will greatly affect moisture contents of unburned fuels in and out of the unit, rate of spotting, and ease of control.

4. Insolation--the angle and time of exposure, which is in part a function of aspect, will influence fuel moisture, fuel temperature, ease of ignition, and rate of spread. Convection activity can be directly influenced by insolation; whirlwind activity on the burn can affect control of the fire.

5. Air temperature--the influence of temperature on fire behavior is similar to that of insolation in that fuel moisture, fuel temperature and convection activity are affected. Surface air temperature can be a function of insolation. Temperature as it affects drying history is critical...not the effects of present temperature.

6. Atmospheric conditions--conditions of the ambient air mass that will affect fire behavior are atmospheric stability or instability.

   a. Stable airmass characteristics:

      1. Thickness of the stable layer averages about 3000 feet. (Range can vary from 100 to thousands of feet).

      2. Thickness varies daily but tends to be the same from one night to the next.

      3. Little or no vertical air motion exists.

      4. Winds within the layer are usually light.

      5. Winds above the layer are stronger.

      6. Smoke dispersal is poor if the burn is more than 3000 feet below the top (of the airmass) unless the fire is extremely intense.

      7. Smoke dispersal, if the burn is between 1500-3000 feet below the top, is...

         ...good from a high intensity burn.
         ...poor from a low intensity burn.

      8. Smoke dispersion is usually good from burns within 1500 feet of the top of the stable layer.

      9. Above the stable layer, smoke dispersion is good even with a low intensity burn; even at night.

10. Fall season stability--stable conditions characteristic of autumn burning periods are quite common and have tremendous impacts on fall burning:

    a. Prolonged stability during the fall occurs even during the daytime hours.
    b. The stable layer is usually very deep.
    c. Daytime heating is insufficient to form an unstable ground layer. Any layer that is formed rarely exceeds 1000 feet and decreases in height as the season progresses.
    d. Adequate smoke dispersion depends entirely on winds and high fire intensity.

b. Unstable airmass characteristics:

1. An unstable layer is usually 4000 feet or more thick; depth will be less on cloudy days or cool days.

2. Vertical air currents are numerous.

3. Smoke dispersion is good and not dependent on winds.

4. Upslope breezes occur on sunny days.

5. Air layers above the heated air remain little changed from nighttime conditions.

c. Levels of stability are important as indicators of the rise of the column due to air temperature change and are defined below:

1. Stable air--ambient temperature decreases at the rate of less than 3.5°F per 1000 feet of increase in elevation.

2. Conditionally unstable air--temperature decreases 3.5°F to 5.4°F per 1000 feet elevation.

3. Unstable air--temperature decreases 5.5°F per 1000 feet. This is the dry adiabatic lapse rate.

4. Absolutely unstable--temperature decreases more than 5.5°F per 1000 feet elevation.

5. An inversion is a layer of extremely stable air in which the temperature increases with increased elevation.

The condition of the airmass is important to the burn. Certain data is needed to determine conditions:

1. The elevation of the top of the stable layer will indicate how high the column must go for good dispersal and can be approximated by observation.

This level will correspond to the top of the maximum concentration of haze. A special weather forecast can also provide this information.

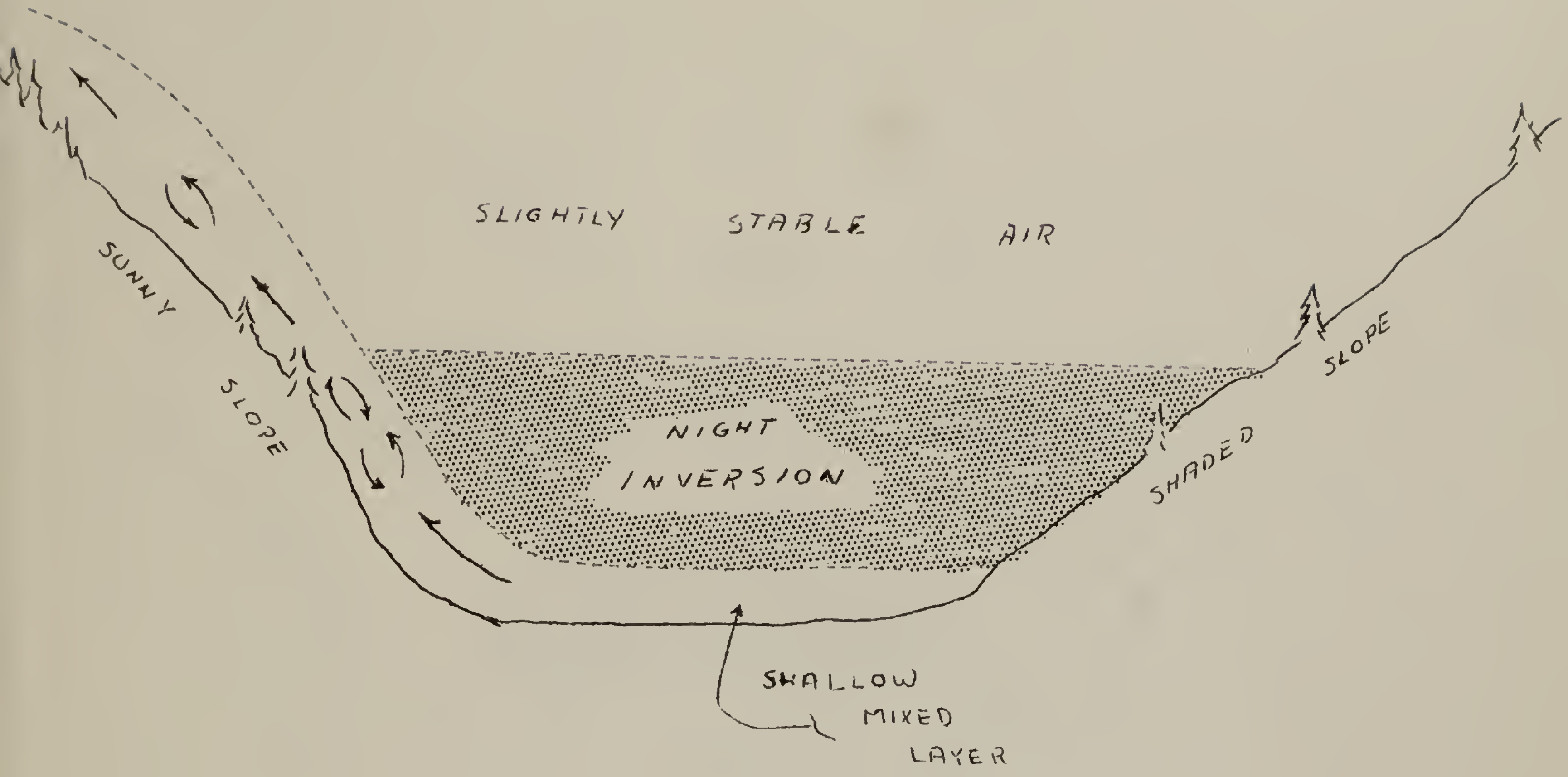
2. The depth of the daytime heated layer. This layer is unstable. If the layer is deep smoke dispersal will be good; if shallow dispersion will not be good. This information can be approximated by the Weather Service, or be estimated by observation. For instance: On a warm summer day with good visability, the layer may be 5000 feet or deeper.

   The elevation of cumulus of stratocumulus clouds indicates the height of the heated layers.

3. The elevation of the burn. This is important, especially under stable conditions. See stable airmass characteristics, preceding page.

   The following pages depict general airmass conditions, their diurnal variations, and their effects on smoke dispersion.

FIGURE 5. EARLY MORNING CONDITIONS



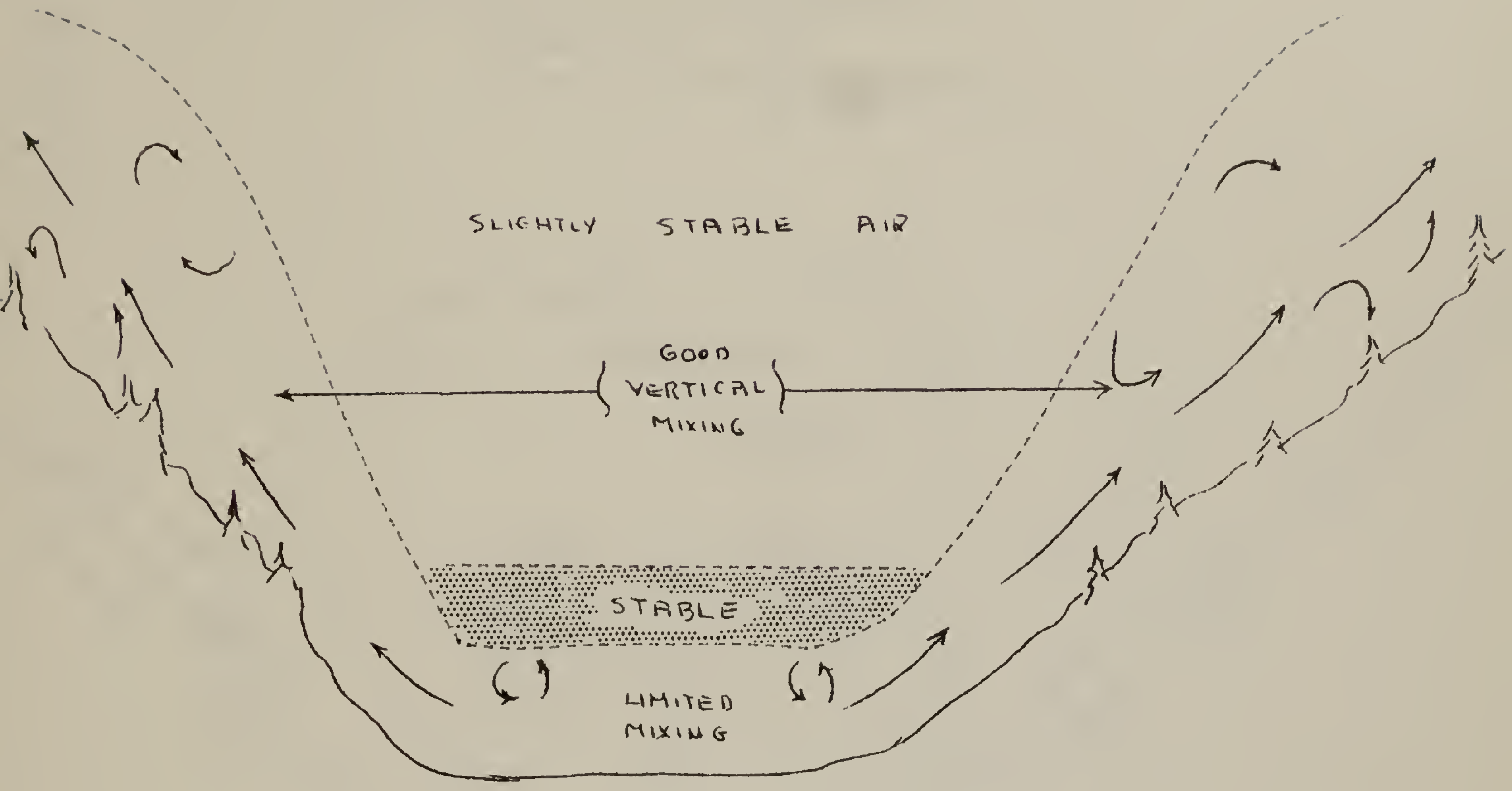
1. The sunny slope is warming, air currents rising.
2. The shaded slope is cool, air currents are stable or downslope.
3. A nighttime inversion in valley bottom still exists.
4. Some shallow mixing may occur below the inversion layer.
5. Slightly stable air exists above the inversion.
6. Smoke dispersal:
    a. Valley - very poor dispersal.
    b. Mid-slope - poor dispersal (especially on the shaded slope) without good winds (except in thermal belt).
    c. High on slope - poor to good dispersal depending on fire intensity and wind speed.

1. [illegible]
2. The shaded [illegible] currents [illegible]
3. [illegible]

[illegible]

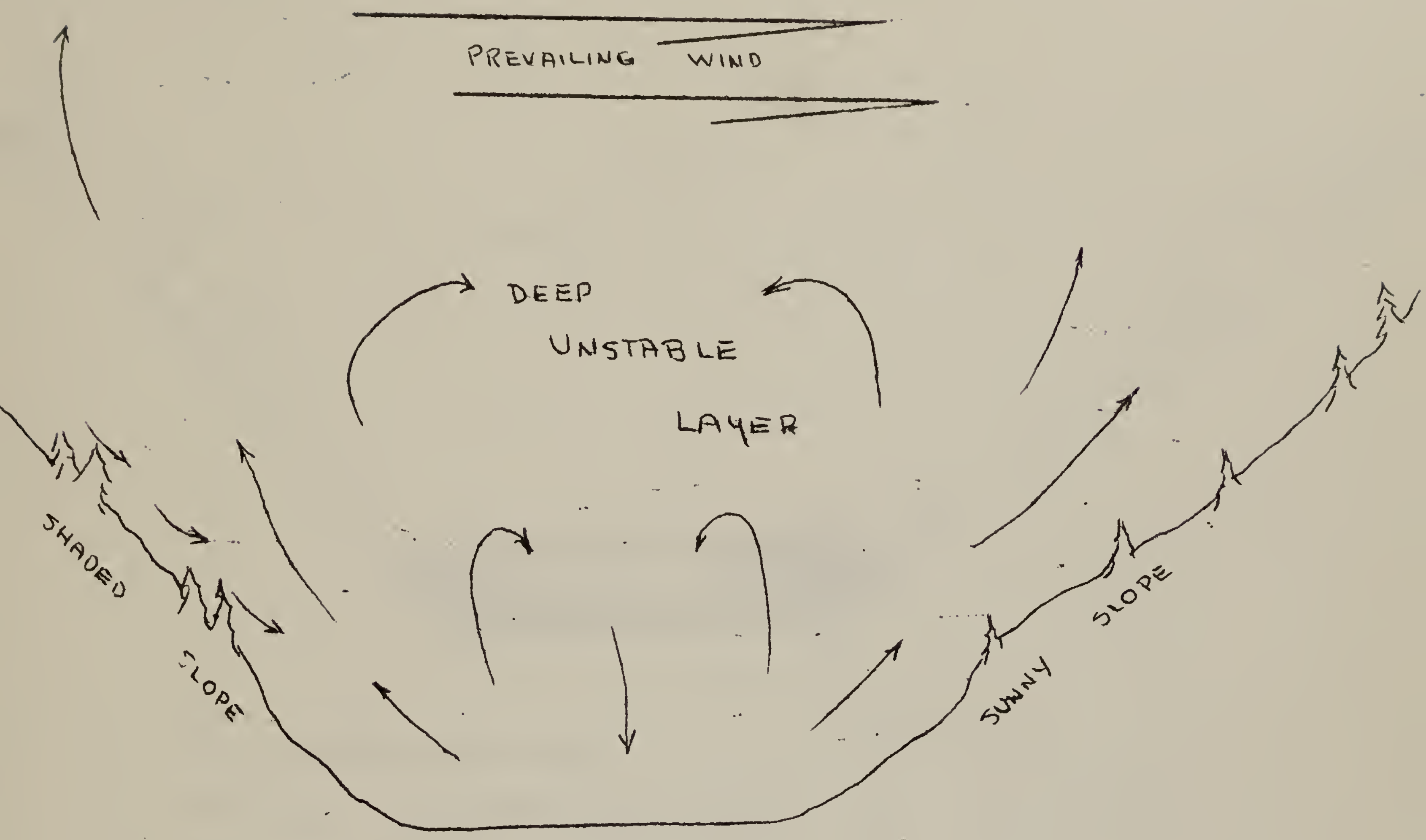
High [illegible] slope [illegible] dispersal direction [illegible] intensity and wind speed.

FIGURE 6. LATE MORNING CONDITIONS



1. All slopes are warmed, air currents generally rising.
2. Some highly stable air exists in the valley.
3. The surface mixing level deepens.
4. Good, deep mixing occurs at higher elevations.
5. Smoke dispersal.
    a. Valley - limited dispersal.
    b. Mid-slope - good dispersal depending on intensity and winds.
    c. High on slope - generally good dispersal.

FIGURE 7. LATE AFTERNOON CONDITIONS



1. Deep mixing layer of unstable air exists generally.

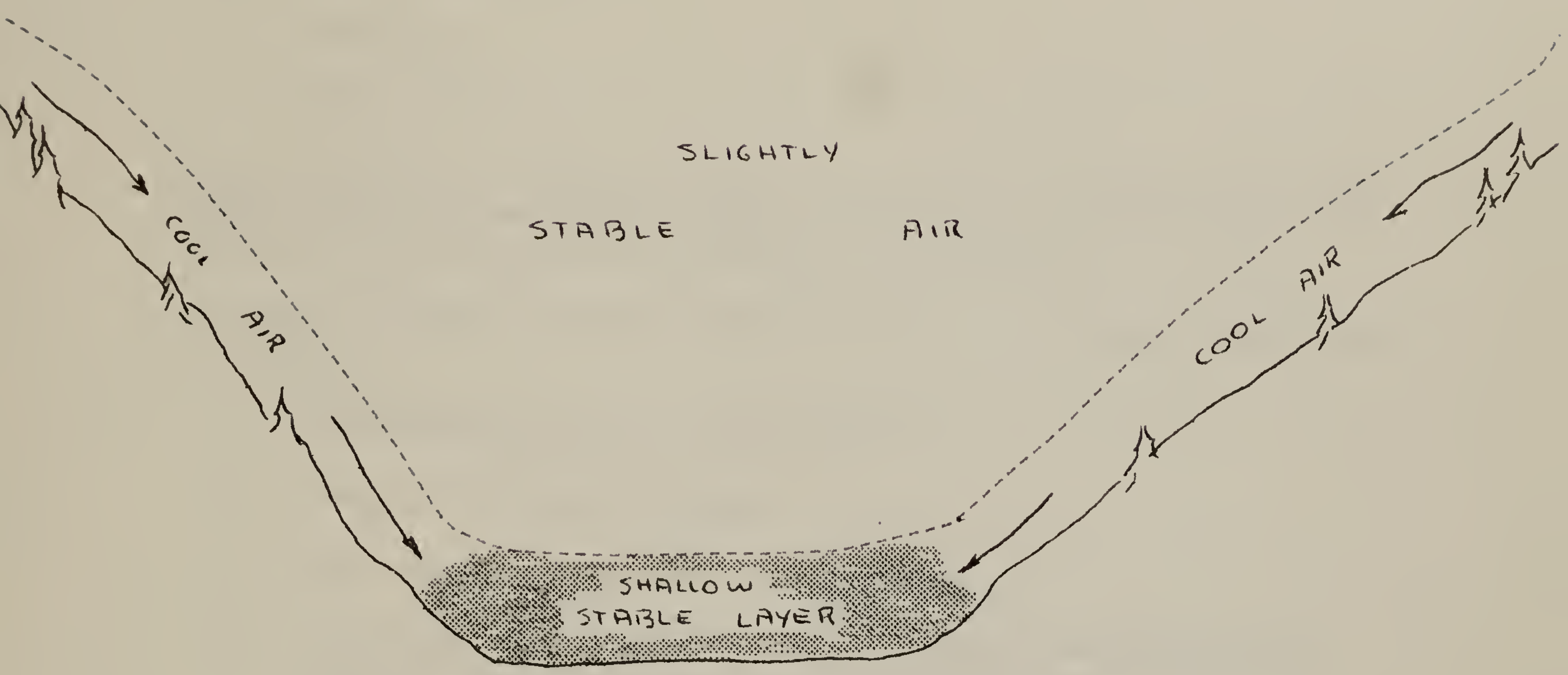
2. Smoke dispersal - good at all elevations.

3. Caution - This unstable condition may not occur during the fall burning season.

   - Residual smoke can become a problem toward nightfall.

   - Control of the fire may be a problem.

FIGURE 8. CONDITIONS AT MIDNIGHT



1. Cool, downslope winds occur.

2. The valley bottom stable layer deepens.

3. Smoke dispersal:

    a. Dependent of fire intensity.

    b. Residual smoke will accumulate in valley.

4. A night inversion layer is beginning to form; due to the temperature increase from bottom to top of layer, the mid-slope will become the thermal belt.

The Weather Service issues a daily forecast on TWX until November 1. During the slash burning period, the forecast includes:

1. Level of free air convection.
2. Winds aloft at 6,000, 9,000, and 12,000 feet.
3. Daily temperature.
4. Humidity.
5. Wind trends.

In most cases, you should be able to apply these trends to your local onsite weather measurements making it unnecessary to request an individual spot forecast for each day or every burn.

In order to prepare accurate spot forecasts, the following information is required:

1. Temperature, dry bulb and wet bulb.
2. Wind direction and velocity.
3. Indicate cloud coverage, thunderstorms, etc.
4. Take measurements between 1400 and 1600 at the site of the day prior to the planned burn. More important would be hygrothermograph (3) readings from the site.
5. If hygrothermoaerograph (3) readings are being reported, be sure to note that wind velocities are per hour averages.
6. Report maximum and minimum readings from onsite hygrothermographs for previous 2 or 3-day period when available.
7. Use Fire-Weather "Spot" Forecast Data Sheet, FC-12, when making requests.

D. TOPOGRAPHIC FACTORS:

1. Unit shape. The shape and location of unit boundary lines depends in part on the terrain. In steep country, place the top lines on ridge tops or other prominent features. Keep bottom lines out of steep, narrow ravine bottoms to avoid spotting.
2. Unit size. Size of individual unit and number of units in one locality should not exceed that which can safely and effectively burn in one burning period. Although the cost per acre of burning decreases as the unit size increases, consider other resource values such as wildlife habitat, local fishery, watershed, etc.

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(3) See #10 and 11, Glossary of Terms

3. Aspect. Consider aspect and associated characteristics of moisture and insolation. Vegetation types will vary according to aspect and will burn differently.

4. Terrain. Geographic features will affect local weather patterns, oftentimes creating erratic winds and erratic fire behavior. Consider the burning unit in relation to the entire drainage.

5. Perimeter Control Lines. All burning units should have a continuous control line around the perimeter. Control lines may be engineered roads, firelines, scarified areas, natural barriers or "burned-black" lines.

   When laying out the unit, take advantage of existing roads, swamps, ponds, streams, rock outcrops, bare areas, recent burns, powerline rights-of-way, etc.

   Firelines are constructed easiest and cheapest through good soil and light fuels. All constructed firelines must be clean and free of flammable material and debris.

   Fireline width is important but varies depending on:

   1. Height of adjacent fuels.
   2. Saddles.
   3. Bends and kinks in line.
   4. Narrow draws.
   5. Adjacent heavy fuel accumulations.
   6. Insurance areas where extra precautions are necessary, such as patches of reproduction outside the line.

   Undercut firelines should be checked and trenched or bermed if necessary, so rolling material will not cross.

   Any needed water catchments should be established including catch basins, tanker-filling areas, etc. Establishment of water basins must coincide with good watershed management practices.

6. Accessibility. Burning crews, holding crews, and equipment need good access to the unit, to various sections of the unit, and to water locations. Tie new roads to existing roads.

7. Streamside zones. Leave green buffer strips along both sides of live streams so burning of the unit will not affect them. Loss of shade to or siltation of the stream degrades water quality and fish habitat.

8. Fragile soils. Carefully consider highly erodible slopes. Choose alternative treatments carefully - fire! - mechanical! - none!

9. Ownership. Locate all ownership lines. Generally, a "reserve" strip between this unit to be burned and adjacent ownership will provide a buffer for fire escapes.

PART VI - AIR QUALITY

Consideration of air quality in prescribed burning is of utmost importance. While the use of fire in land management is necessary, such use must be judicious and provide a minimum adverse impact upon the atmosphere, especially that part considered the social environment.

Air pollution is defined as "the presence in the outdoor atmosphere of one or more contaminants in sufficient quantities of such characteristics and duration as is, or likely to be, injurious to human health, plant or animal life, or property, or which unreasonably interferes with enjoyment of life and property." (4) This definition is essentially the one adopted by most air pollution agencies, including the Montana Department of Health and the Missoula City-County Health Department.

Factors affecting air-quality and contributing to air pollution are numerous, occurring both naturally and due to man's influence. Naturally occurring contaminants include dust, ash, smoke, fog. Other natural contributors are stable airmass layers, low wind speeds and topographic effects on air flow patterns.

Nature has built-in mechanisms to periodically cleanse the atmosphere of contaminants and impurities. Unstable airmasses mix these impurities, winds dilute their effects and precipitation washed them from the air. This occurs also with manmade contaminants; however, these are being produced at rates which tax natural cleansing actions.

Smoke, as one of man's contaminants, is the only one with which these guidelines are concerned. Some research is presently taking place to determine smoke's effects as a pollutant. However, for purposes here, only the obvious effect will be considered .... smoke is visible.

Contrary to popular belief, smoke, once it has risen, as part of the convection column, cannot descent (excepting explanation follows). In order to rise, the smoke must be warmer than the ambient air. As it rises, it cools until it reaches a temperature equilibrium with the air around it. At this stratum, smoke will no longer rise.

Smoke particles, for the most part, are aerosols and average approximately .25 micron in size. A particulate of 1 micron will fall at the rate of 3.5 feet per hour (or 1000 feet in 12 days). For all practical purposes, smoke remains airborne until, acting as a nucleus for precipitation, it is washed from the air.

Smoke moves with its stratum. If that layer, due to air currents, descends then so will the smoke. Smoke can, in this manner, descend. This phenomena of descending airmasses is uncommon but does occur occasionally; and is usually concurrent with pronounced frontal activity.

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(4) Puget Sound Air Pollution Control Agency

BURNING CONSTRAINTS

Some constraints are necessary to minimize the impact of smoke upon the social environment.

1. At the time of ignition, fuels should be as dry as practical, consistent with burning objectives and existing fire control needs. Burning should be done when the intended fuel burns briskly and completely.

2. Except when control needs dictate otherwise, early to midafternoon burning is encouraged to attain maximum convection column height and smoke dispersal.

3. On sites where drift smoke may be a problem, ignition should be scheduled to minimize drift during conditions of downslope winds and low level smoke accumulation (especially nighttime conditions). Consider airmass stability factors.

4. Restrict burning during dry periods that would require extensive mopup, unless project funds are available for such treatment. Mopup to wildfire standards.

5. Maximum smoke dispersion is essential for all burning operations; however, burns planned upwind of any critical areas such as recreational areas, areas of habitation, main transportation routes, or urban and industrial areas may require more stringent precautionary measures. Area Supervisors should delineate all critical areas within his jurisdiction.

6. Burns will be scheduled to avoid drift smoke accumulation in adjacent valleys. Such precautions may require extra action to extinguish smoldering remnants when a clean burn is not attained as planned. In critical areas, non-burning alternatives may be necessary.

7. Attention to local publicity is necessary to keep the public informed so they will understand that the burning is adequately planned and burning is required for effective resource management.

8. Spring burning for improvement of game habitat is quite beneficial. Since this type of burning usually involves light fuels, the weather conditions desirable for smoke dispersal are also desirable for meeting the objectives of habitat improvement.

   Spring burning on a large scale in heavy fuels does not appear possible at present because of limited favorable weather conditions and the hangover fire hazard involved. Where applicable, spring burning on warm, dry slopes is most desirable as soon as the snow melts and before any new grass develops. This is usually in April or May. Any spring or early summer burning requires:

   1. Extensive mopup.

   2. Periodic intensive patrol.

3. Notification and close coordination with the proper protection agency.

9. Information, records and measurements on smoke pollutants resulting from forest burning operations are needed. Areas will be requested to prepare a simple report and evaluation form (Prescribed Fire Smoke Report, Appendix) for each burning operation for recording height of convection column, direction of smoke movement, duration of drift smoke, and evaluation of impact on local air quality.

For most efficient smoke management, consider the following guidelines:

1. Insured rapid ignition - i.e. maximum heat energy per unit of time.
2. Begin early in the day - following effects of nighttime stability.
3. Burn cured material - not green.
4. Burn with the strongest winds that can be tolerated for safety, control and burning objectives.
5. Burn with the maximum instability that can be tolerated for safety and control.
6. Burn when winds aloft are strong (and in the desired direction) at the elevation to which the plume will rise.
7. Burn when winds are away from critical, smoke sensitive areas.
8. Spread burning out over a longer portion of the year. Reduce overburdening the self-cleansing processes of the atmosphere.
9. The burning of slash, when smoke column characteristics are good but control in any way is marginal, will not be accomplished unless funding is adequate to finance the occasional escape fire.
10. Fuel moisture content should be between 6 and 15% for most effective burning.
11. Optimum relative humidity for burning is between 20 and 40%; spotting is likely when the relative humidity is below 20%.
12. Surface windspeed should be under 10 miles per hour to enhance control.

The responsibility of the Area Supervisor, or his delegated representative, is to:

1. Coordinate all burning projects and burning crews between units and forests and within the Area.
2. Conduct burning operations in accordance with air quality guidelines.

3. Supervise all burning projects including slash and brush projects.

4. Prepare and submit plans for the current year's prescribed burning.

5. Insure that required permits to burn are obtained:

    a. During the closed fire season, from the appropriate protection agency, and

    b. At all times, from the local County Health Department.

6. Prepare and submit burning plans on any unusual burns to the Chief, Operations Bureau for review.

MONTANA ENVIRONMENTAL QUALITY ACT

The following policy statement comes from Section 2 of the 1971 Environmental Quality Act:

> It is the policy of the State to "encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the State..."

This, plus the following excerpts from the Montana Statutes, declare we insure quality in all our management practices, including prescribed burning.

MONTANA CLEAN AIR ACT

The following are excerpts from Sections 69-3904 - 69-3923 RCM, otherwise known as the "Clean Air Act of Montana."

> "(1) It is hereby declared to be the public policy of this state and the purpose of this act to achieve and maintain such levels of air quality as will protect human health and safety, and to the greatest degree practicable, prevent injury to plant and animal life and property, foster the comfort and convenience of the people, promote the economic and social development of this state and facilitate the enjoyment of the natural attractions of this state.
>
> "(2) It is also declared that local and regional air pollution control programs are to be supported to the extent practicable as essential instruments for the securing and maintenance of appropriate levels of air quality.
>
> "(3) To these ends it is the purpose of this act to provide for a coordinated state-wide program of air pollution prevention, abatement and control; for an appropriate distribution of responsibilities among the state and local units of government; to facilitate cooperation across jurisdictional lines in dealing with problems of air pollution not confined within single jurisdictions; and to provide a framework within which all values may be balanced in the public interest."

- Administration

> 'The State Board of Health shall have the responsibility for the administration of this act and shall appoint a director of air pollution control to assist the board in its administration hereunder..."

- Air Pollution Control Advisory Council

  "There is hereby created an air pollution control advisory council. The advisory council shall consist of eleven (11) members...

  "The advisory council may consider standards, rules and regulations as provided in Section 69-3913 and any other matter related to the purposes of the act, which may be submitted to it by the board. It may make recommendations to the board on its own initiative concerning the administration of this act."

- Powers of Board

  "In addition to any other powers conferred on it by law the board shall:

  (1) Adopt, amend, and repeal rules implementing and consistent with the provisions of this act.

  (2) Hold hearings relating to any aspect of or matter in the administration of this act, at any place or places designated by the board....

  (3) Issue such orders as may be necessary to effectuate the purposes of this act and enforce them by all appropriate administrative and judicial proceedings.

  (4) Require access to records relating to emissions.

  (5) Secure necessary scientific, technical, administrative, and operational service, including laboratory facilities, by contract or otherwise.

  (6) Prepare and develop a comprehensive plan or plans for the prevention, abatement and control of air pollution in this state.

  (7) Encourage voluntary cooperation by persons and affected groups to achieve the purposes of this act.

  (8) Encourage local units of government to handle air pollution problems within their respective jurisdictions on a cooperative basis, and to provide technical and consultative assistance therefore....

  (9) Encourage and conduct studies, investigations, and research relating to air contamination and air pollution and their causes, effects, preventions, abatement, and control.

  (10) Determine by means of field studies and sampling the degree of air contamination and air pollution in the state and the several parts thereof.

  (11) Make a continuing study of the effects of the emission of air contaminants from motor vehicles on the quality of the outdoor atmosphere of this state and the several parts

thereof, and make recommendations to appropriate public and private bodies with respect thereto.

(12) Establish ambient air quality standards for the state....

(13) Collect and disseminate information and conduct educational and training programs relating to air contamination and air pollution.

(14) Advise, consult, contract, and cooperate with other agencies of the state, local governments, industries, other states, interstate and inter-local agencies, the United States, and any interested persons or groups.

(15) Consult, upon request, with any person proposing to construct, install or otherwise acquire an air contaminant source or device or system for the control thereof, concerning the efficacy of such device or system,

(16) Accept, receive, and administer grants or other funds or gifts from public or private agencies, including the United States, for the purpose of carrying out any of the functions of this act...."

- Classification and reporting

"(1) The board may classify air contaminant sources which in its judgement may cause or contribute to air pollution according to levels and types of emissions and other characteristics which relate to air pollution, and may require reporting for any such class or classes....

"(2) Any person operating or responsible for the operation of air contaminant sources of any class for which the rules of the board may require reporting shall make reports containing such information as may be required...."

- Permits

"(1) The board may, by rule or regulations, prohibit the installation, alteration, or use of any machine, equipment, device or other article which it finds may cause or contribute to air pollution or which is intended primarily to prevent or control the emission of air pollutants, unless a permit therefore has been obtained from it...."

- Inspections

"(1) Any duly authorized officer, employee, or representative of the board may enter and inspect, at any reasonable time, any property, premises, or place, except a private residence, on or at which an air contaminant source is located or is being constructed or installed for the purpose of ascertaining the state of compliance with this act and rules in force pursuant thereto...."

- Emissions prohibited

"(1) The board may establish the limitations of the levels, concentrations, or quantities of emissions of various pollutants from any source necessary to prevent, abate or control air pollution...."

- Enforcement

"(1) Whenever the board has reason to believe that a violation of any provision of this act or rule made pursuant thereto has occurred, it may cause written notice to be served upon the alleged violator or violators...."

- Emergency procedure

"(1) ---- if the director finds that a generalized condition of air pollution exists and that it creates an emergency requiring immediate action to protect human health or safety, the director shall order persons causing or contributing to the air pollution to reduce or discontinue immediately the emission of air contaminants.

"(2) In the absence of any such generalized condition...., if the director finds that emissions from the operation of one or more air contaminant sources is causing imminent danger to human health or safety, he may order the person or persons responsible for the operation or operations in question to reduce or discontinue emissions immediately...."

- Local air pollution control programs

"(1) Any municipality or county may establish a local air pollution control program upon being petitioned by fifteen per cent (15%) of the qualified electors within its jurisdiction, and may thereafter administer within its jurisdiction said air pollution control program which:

(a) Provides by ordinance or local law for requirements compatible with, more stringent, or more extensive than those imposed by sections 69-3913, 69-3915 and 69-3916 and rules issued thereunder;

(b) Provides for the enforcement of such requirements by appropriate administrative and judicial process;

(c) Provides for administrative organization, staff, financial and other resources necessary to effectively and efficiently carry out its program;

(d) Provided that such program shall be consistent with the intent and purposes of this act and is approved by the board after a public hearing conducted according to the provisions of section 69-3909.

"(2) If the board finds that the location, character, or extent of particular concentrations of population, or air contaminant sources, or geographic, topographic, or meteorological considerations, or

> any combinations of any of the foregoing, are such as to make impracticable the maintenance of appropriate levels of air quality without an areawide air pollution control program, the board may determine the boundaries within which such program is necessary and require it as the only acceptable alternative to direct state administration...."

In addition, the State Board of Health is empowered to issue certain regulations to help in the administration of its assigned programs.

MONTANA BOARD OF HEALTH REGULATION - 90-010

Open Burning Restriction

The following excerpts from the above regulations are applicable to prescribed burning:

> "No person shall cause, suffer, allow or permit an open fire except under the following conditions:
>
> 1. When such fire is set or permission for such fire is given in the performance of the official duty of a public officer, and in the opinion of the control officer is necessary:
>   a. "For the purpose of the elimination of a fire hazard which cannot be abated by any other means.
>   b. "For instruction in methods of fighting fires.
>   c. "For the purpose of removing any hazardous material.
> 2. "When such is set in the course of an essential agricultural operation in the growing of crops or in the course of accepted forestry practices provided no public nuisance is created and provided a permit has been secured from the control officer.
> 3. "When fires are set for the clearing of lands for new roads under conditions stipulated in writing by the control officer and after having applied for and received a permit for such open fire from the control officer."

The following is a memorandum change of policy issued by the Department of Health and should be considered as part of the above regulations:

> "Beginning as soon as possible, the major radio and television stations will be contacted throughout the state when this office receives a Pollution Potential Advisory which affects Montana. The Pollution Potential Advisory is an indication that stagnation conditions will or do exist. At such a time air pollution continues to build up substantially without any dilution. During these times all burning will be prohibited. No permits will be granted until such time as the end of the Air Pollution Advisory has been determined. At the end of the Pollution Potential Advisory burning permitted under regulation 90-010 may continue with a permit."

MONTANA WATER QUALITY ACT

While these guidelines generally concern themselves with the effects of burning on the atmosphere, it is appropriate that water quality be maintained and concern be expressed, as any burning effects the streams. Also the Montana Hazard Reduction Agreement requires compliance with these sections.

The following excerpts from Sections 69-4801 - 69-4819, RCM, on water pollution are applicable to prescribed burning:

Water Pollution - Public Policy.

> (1) "It is the public policy of this state to:
>
> (a) Conserve water by protecting, maintaining, and improving the quality and potability of water for public water supplies, wildlife, fish and aquatic life, agriculture, industry, recreation, and other beneficial uses;
>
> (b) Provide a comprehensive program for the prevention, abatement, and control of water pollution.
>
> (2) "It is not necessary that wastes be treated to a purer condition than the natural condition of the receiving stream. 'Natural' refers to conditions or materials present from runoff or percolation over which man has no control or from developed land where all reasonable land, soil and water conservation practices have been applied...."

- Administration

> "Except as otherwise provided, the department, acting under the supervision of the board as to matters of policy is responsible for administration of the provisions of this chapter...."

- Pollution unlawful

> "It is unlawful to:
>
> (1) Cause pollution as defined in Section 69-4802 (5) RCM 1947 (See Glossary) of any state waters or to place or cause to be placed any wastes in a location where they are likely to cause pollution of any state waters....
>
> The Department shall:
>
> "....collect and furnish information relating to the prevention and control of water pollution, conduct or encourage necessary research and demonstrations concerning water pollution."

The following are excerpts from additional regulations to help the Board administer its programs.

Montana State Water Pollution Control Council Policy Statement:

> "Waters whose existing quality is better than the established standards as of the date on which such standards become effective will be maintained at that high quality unless it has been affirmatively demonstrated to the state that a change is justifiable as a result of necessary economic or social development and will not preclude present and anticipated use of such waters. Any industrial, public or private project or development which would constitute a new source of pollution or an increased source of pollution to high quality waters will be required to provide the necessary degree of waste treatment to maintain high water quality...."

GLOSSARY OF TERMS

1. Adiabatic Lapse Rate:

The rate at which unsaturated air cools as it lifts. This is approximately 5.5°F per 1000 feet increase in altutude. (Also dry-adiabatic rate; or lapse rate). (2)*

2. Aerosol:

Solid or liquid particulates in the atmosphere under 1 micron in size.

3. Air Contaminant:

Dust, fumes, mist, smoke, or other particulate matter, vapor, gas, odorous substance, or any combination thereof. (Sec. 69-3906, RCM, 1947)*

4. Air Pollution:

The presence in the outdoor atmosphere of one or more air contaminants in such quantities and duration as is or tends to be injurious to human health or welfare, animal or plant life or property, or would unreasonably interfere with the enjoyment of life or property. (Sec. 69-3906, RCM, 1947)

5. Ambient Air:

The surrounding atmosphere. (Webster's 7th New Collegiate)

6. Atmospheric Stability:

Resistance of the atmosphere to vertical motion. (Also stable or unstable air mass) (2)

7. Ecology:

The study of plants and animals in relation to their environment. (8)

8. Ecosystem:

Any complex of living organisms with their environment, that "we isolate mentally for purposes of study." (8)

9. Emission:

A release into the outdoor atmosphere of air contaminants. (Sec. 69-3906, RCM, 1947)

10. Hygrotherograph:

An instrument that records both humidity and temperature on the same chart for extended periods to obtain diurnal variations.

---

* ( ) Indicates reference to glossary source. See References and Suggested Reading.

11. Hygrothermoaerograph:

A standard hygrothermograph modified to record wind movement as well as humidity and temperature.

12. Inversion:

An extremely stable layer of air in which the temperature increases with height and is extremely resistant to vertical motion. (2)

13. Mixing Depth:

The expanse in which the warm air rises and mixes with the ambient air. (1)

14. Open Fire:

A fire where any material is burned in the open air or in a receptacle other than fuel burning equipment or multiple chamber incinerator.

15. Particulate Matter:

Any material except water in uncombined form, that is or has been air-borne and exists as a liquid or solid at standard conditions. (Board of Health)

FIRE-WEATHER "SPOT" FORECAST DATA SHEET

FC-12

Request sent to: ________________ for relay to Weather Service Time: __________

Time request made __________ Date ______________ Name of Fire __________________

Location of going fire or prescribed burn:

¼ section __________________ Section __________ Twp: ____________ Rge: ________

Name of drainage ____

Size of fire ____

Exposure _________________ Elevation bottom of fire __________ Top _________

Fuel type ____

Present weather and wind conditions at fire (or from two stations near fire). Report wind at time of observation, not averages.

Dry bulb _________________________ Wet bulb ____________________________

Wind direction from ____

Wind speed _______________________ Gusty _______________________________

Estimated wind direction and velocity across ridges in vicinity of fire:

Direction ________________________ Velocity ____________________________

Above readings taken at place ______________________ Time _________________

Elevation of observation point ______________ feet.

Send forecast to ____

Forecast relayed to ____________________________________ Time ____________

Time forecast received _________________

By __________________________________

FORECAST AND OUTLOOK:

DEPARTMENT OF NATURAL RESOURCES & CONSERVATION

MDF-1972 MONTANA DIVISION OF FORESTRY

PRESCRIBED FIRE SMOKE REPORT

Use this form to record smoke behavior resulting from Division burning operations. Prepare a separate report for each prescribed burning project. Information for completion of form should be sources already available or your best estimate. Send one copy to Chief, Operations Bureau and file one copy with Area records.

Area____________________ Unit____________________

Project____________________ Location____________________
(General - drainage - etc.)

Size (Acres)____________________ Date and Time of Ignition____________

Objectives of Burn (Wildlife, hazard reduction, site preparation, etc.)__________

____

A. Fuel Description:

1. Type of preparation: (Check one or more)

Logging slash____ Machine piled____ Spot or jackpot____ Road slash____

Thinning slash____ Clearing slash____ Hand piled____ Broadcast______

Other (Describe)______________________________

2. Fuel volume per acre: (Check one)

Light________ Medium________ Heavy________

3. Type of fuels: (Describe)____________________________

____

4. Age of slash or debris burned:________________________
(Time since cutting)

B. Topography:

1. Aspect:________; Slope %:________; Elevation:________

2. Position on slope: (Check one) Upper 1/3____ Middle 1/3____ Lower 1/3___

3. Unusual or pertinent topographic conditions:____________________

____

____

____

C. Fire Behavior:

1. Burn intensity: Hot______ Medium______ Cool______

2. Rate of spread: Flashy______ Rapid______ Medium______ Slow______

D. Weather:

1. Surface wind on burn at time of ignition: (Estimate) Velocity______ Direction______

Winds aloft or gradient winds as described in fire-weather forecast, if available:______

2. Humidity on burn at time of ignition: Measured______ Estimated______

3. Temperature on burn at time of ignition: Measured______ Estimated______

4. Mixing depth, if available (from fire-weather forecast):______

5. Cloud cover (to nearest 10%):______

6. Build up Index:______ Station______

7. Was spot weather forescast requested specifically for this burn? Yes___ No_____

E. Smoke Conditions:

1. Convection column or smoke plume: Weak______ Well formed______

Height above fire: High______ (5000'+) Medium______ (500' to 5000') Low______ (Less than 500')

2. Direction of smoke movement:______ (NW, SW, NE, etc.)

3. Describe smoke conditions the day after ignition: i.e. volume of smoke, direction of drift smoke, is smoke hanging in adjacent drainages or dissipating currently?______

______

______

______

4. Estimated number of days that burn was smoking enough to be noticeable from locations of public use:______

______

______

______

MONTANA STATE DEPARTMENT OF HEALTH

APPLICATION FOR OPEN BURNING PERMIT

1. Name of Applicant

2. Address Telephone

3. Corporate Name Telephone

4. Address

5. Area and Location of Burning

6. Date of Burn Time Start Time Stop

7. Material to be burned.

   a. Type ______________________________
   b. Quantity ______________________________
   c. Composition ______________________________

8. Reason why no method other than open burning can be used for disposal:

   ____
   ____
   ____
   ____

9. Evidence provided that fire department or other fire control officer has approved burning

   Yes -- Name and Department ______________________________
   ____

   No -- State Why ______________________________
   ____

FOR OFFICIAL USE ONLY

Permit Reviewed By: ______________________________ Date: ______________

☐ Approved Permit No. ______________
☐ Denied

Result of Action: Describe pollution conditions resulting from approval or compliance or legal action of denial.
What alternative was used in case of denial?

REFERENCES AND SUGGESTED READING

1. "Air Pollution Primer"; National Tuberculosis and Respiratory Disease Association; New York, 1969.

2. "Fire Weather"; Mark J. Schroeder and Charles C. Buck; U.S.F.S., Agricultural Handbook #360, May 1970.

3. "Guides to the Administration of State-owned Forest Land"; Office of Montana State Forester; Missoula, Rev. 1971.

4. "Hazard Reduction and Management Guidelines"; Division of Forestry, Missoula, Rev. 1972.

5. "Prescribed Fire Planning in the Intermountain West"; Wm. R. Beaufait, U.S.F.S., Int-26,1966.

6. "Prescribed Fire Smoke Dispersion Principles"; Wm. R. Beaufait and Owen P. Cramer; U.S.F.S. R-1 In-service Publication - 5100, 1969.

7. "Principles of Forest Fire Management"; Raymond C. Clar and Leonard R. Chatten; California State Board of Forestry, Rev. 1966.

8. "Terminology of Forest Science, Technology, Practice and Products"; Multilingual Forestry Terminology Series No. 1, SAF, 1971.

9. "The Role of Fire in the Intermountain West"; Proceedings from the Intermountain Fire Research Council, Missoula, Montana; October 1970.

MEMORANDUM OF AGREEMENT

________________, 1972

The Montana Department of Health and Environmental Sciences, Air Quality Bureau; Department of Natural Resources, Division of Forestry; USDA Forest Service, Northern Region; Bureau of Land Management; and Bureau of Indian Affairs agree to cooperate in a smoke management program in the State of Montana.

These agencies are dedicated to the preservation of air quality in Montana. However, the continuing importance of prescribed burning for removal of logging residue to assure protection and regeneration of forest areas and for other accepted forest practices, such as wildlife habitat improvement, is recognized.

The objectives of this agreement and program are:

1. To minimize or prevent the accumulation of smoke in Montana when prescribed burning is necessary for conduct of accepted forest practices such as hazard reduction, regeneration, and wildlife habitat improvement. The development of alternative methods shall be encouraged when such methods are practical.

2. To develop a smoke management plan for reporting and coordinating burning operations on all forest lands in the State. Guidelines in the plan will be based upon the principles of and technical information currently available on smoke dispersion and on State and Federal air quality regulations.

FIRE HAZARD REDUCTION OR MANAGEMENT LAW

Sections 28-404 through 28-412, Revised Codes of Montana, 1947

28-404. Reduction or Management of Fire Hazard Created by Cutting Timber

Everyone engaged, or about to engage, in the cutting of any forest product or conducting stand improvement such as, but not limited to, thinning, weeding and pruning, upon private lands within the state of Montana shall provide for the reduction or management of the fire hazard to the property of others thus created or to be created by entering into a fire hazard reduction agreement as provided in sections 28-408 to 28-412, or by posting a bond to the state of Montana in such form and for such amount as may be prescribed by the State Forester; provided, however, that the amount of the bond so prescribed shall not be in excess of the amount which such person would be required to pay under said sections 28-408 to 28-412, and that the bond shall be conditioned upon full and faithful compliance with all requirements under said sections 28-408 to 28-412, and the faithful reduction or management of such fire hazards in the manner prescribed by law. Such bond shall be released upon completion of the work in compliance with the terms of the bond. The State Forester shall issue a certificate of compliance with the terms of this section to all persons who have complied therewith.

History: En. Sec. 1, Ch. 207, L. 1959.

28-405. Reduction of Slash and Forest Debris Along Right-of-Way.

Everyone clearing right-of-way for any railroad, public highway, public trail, private road, trail, ditch, dyke, pipeline or wire lines, or any other transmission or transportation utility right-of-way, except temporary roads located within the boundaries of the cutting area and which are used in the actual logging operations, shall reduce the hazard resulting from such clearing or from the cutting of material for the construction of such public or private utility unless exempted by the State Forester.

Hazard reduction, including burning where this method of disposal is used, shall be done as rapidly as cutting or clearing progresses; provided that upon application to the State Forester he may grant a permit extending the time within which such burning must be done in compliance with all the provisions of this chapter relating to burning permits during the closed season.

The provisions of the section shall apply to all clearing of rights-of-way across private land and on behalf of the state, county, highway districts and road districts, whether the work be done by day labor, or by contract, and unless unavoidable emergency prevents, provision shall be made by the proper officials conducting, directing, or letting said work for withholding until it is complete, a sufficient portion of the payment therefor to assure compliance with this act.

Violations of any of the provisions of this section shall be deemed a misdemeanor and be punishable by a fine of not less than One Hundred Dollars ($100.00) nor more than One Thousand Dollars ($1,000.00).

3. Initiate the proposed cooperative smoke management program during the 1972 season. At the end of the season, evaluate the program, review the agreement, and improve the smoke management plan where feasible.

Agreed to by:

____________________________ ____________________________

____________________________ ____________________________

____________________________ ____________________________

STATE OF MONTANA

COOPERATIVE SMOKE MANAGEMENT PLAN

Policy

The cooperative effort of all agencies involved in the use of prescribed burning for disposal of slash and other accepted forest practices is essential for the success of this plan.

Each land management agency is responsible for proper smoke management in its area of operations. Each agency will have an operational plan of action enabling them to reduce burning, eliminate burning in certain areas, or stop burning entirely when meteorological conditions warrant.

The State Department of Health and Environmental Sciences, Air Quality Bureau, is responsible for monitoring forecasts and air quality data, and for notifying each land management agency when acceptable limits of smoke accumulation threaten to be exceeded.

Operational Plans

Smoke management plans will be developed and carried out at two levels through: (1) Local airshed coordination groups, and (2) a Statewide coordination group. The duties and basic methods of operation of the two groups will be as follows:

I. Airshed Coordination Group

A. Duties:

1. Meet annually to coordinate burning plans and discuss methods of operation.

2. Determine methods of local enforcement of acceptable air quality levels during burning seasons.

3. Establish means of communication with the State Air Quality Coordination Group.

4. Inform the State group daily, during burning seasons, of the air quality level within the airshed:

    a. Satisfactory
    b. Unsatisfactory, continuing to build
    c. Unsatisfactory, reducing

5. Establish means of communication within the group to disseminate air quality information.

6. Inform the State group of outside disruptions.

B. Basic Method of Operation

A local group will be established for various airsheds consisting of those agencies involved in burn operations, the local Department of Health representatives, sheriffs' offices, and others.

This local group will meet annually to set up and establish methods of communication, etc., during burning seasons. One agency will be designated by the group as the clearinghouse for the local group.

The Department of Health representatives will monitor air quality levels during burning seasons and notify the clearinghouse when unacceptable levels are reached within the airshed. This

information will be disseminated by the clearinghouse to all participating agencies. These agencies should then voluntarily adjust their burning to help bring the air quality conditions back to an acceptable level. Once the Department of Health determines an acceptable level has been reached, the clearinghouse will be notified of this condition.

If participating agencies do not voluntarily adjust burning plans and are contributing to unacceptable airshed air quality levels, the Department of Health may take those actions, authorized under State and local regulations, to curb this open burning.

The local clearinghouse, with the advice of the local Department of Health will notify the State group when outside influences are creating or contributing to unacceptable local airshed air quality levels.

II. State Coordination Group

A. Duties:

1. Meet annually to discuss methods of operation, levels of and locations of workload for burning seasons.

2. Establish means of communication to disseminate air quality information to the local airshed groups.

3. Establish means of communication with adjoining states that may affect, or have an effect on Montana air quality conditions.

4. Notify the local airshed clearinghouse when operations within their airshed are creating problems for adjoining airsheds.

B. Basic Method of Operation

A Statewide group will be established consisting of agencies involved in burn operations and the State Department of Health. This group will meet annually to set up and establish methods of communication with local airshed groups, and with adjoining states. One agency will be designated as the clearinghouse for this State group.

The State Department of Health will monitor Statewide air quality conditions during the burning season and notify the clearinghouse when unacceptable levels are being reached that are not being coped with by single airshed groups. This information will be disseminated by the clearinghouse to the various airshed groups. These airshed groups should then voluntarily adjust their burning to help bring the air quality conditions back to an acceptable level. Once the State Department of Health determines that an acceptable level has been reached, the clearinghouse will be notified of this condition.

If participating agencies do not voluntarily adjust burning plans, and are contributing to unacceptable air quality levels, the State Department of Health may take those actions authorized under State statutes to curb this open burning.

When outside influences are contributing to unsatisfactory air quality levels within Montana, the State clearinghouse will communicate this information to the State involved.

Information, of a significant nature, which any participating agency wishes to pass on to local airshed groups may be done through the State clearinghouse.